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ABSTRACT

This book describes how parents can develop a mathematical environment for children in the home. Four major areas are emphasized: whole numbers, fractions, decimals, and basic geometry. Section 1 "'Shoebox' Activities," provides activities to teach specific concepts within a manageable time period. Materials are listed and diagrams illustrate procedures. A discussion guide can assist in preparing dialogue leading to verbal and computational understanding. Section 2, "Quickies," is a fun section containing problems to challenge the child to think and look for reasons or patterns. Section 3, "Story Problems," contains word problems presented in the form of stories. Section 4, "Arithmebuildity," calls for applying skills and knowledge already gained and using higher order thinking skills and imagination. Section 5, "Reinforcers," looks for everyday chores or involvements that have benefits related to mathematics. The description of each activity is 1-3 pages in length, and contains a very brief discussion of the concept student, a list of materials needed, the procedure, observations to note and a brief discussion. Age appropriateness is also indicated. Appendices include a list of necessary materials, math related toys and games, and math related books for children. Also included are answer guides and a glossary. (MKR)

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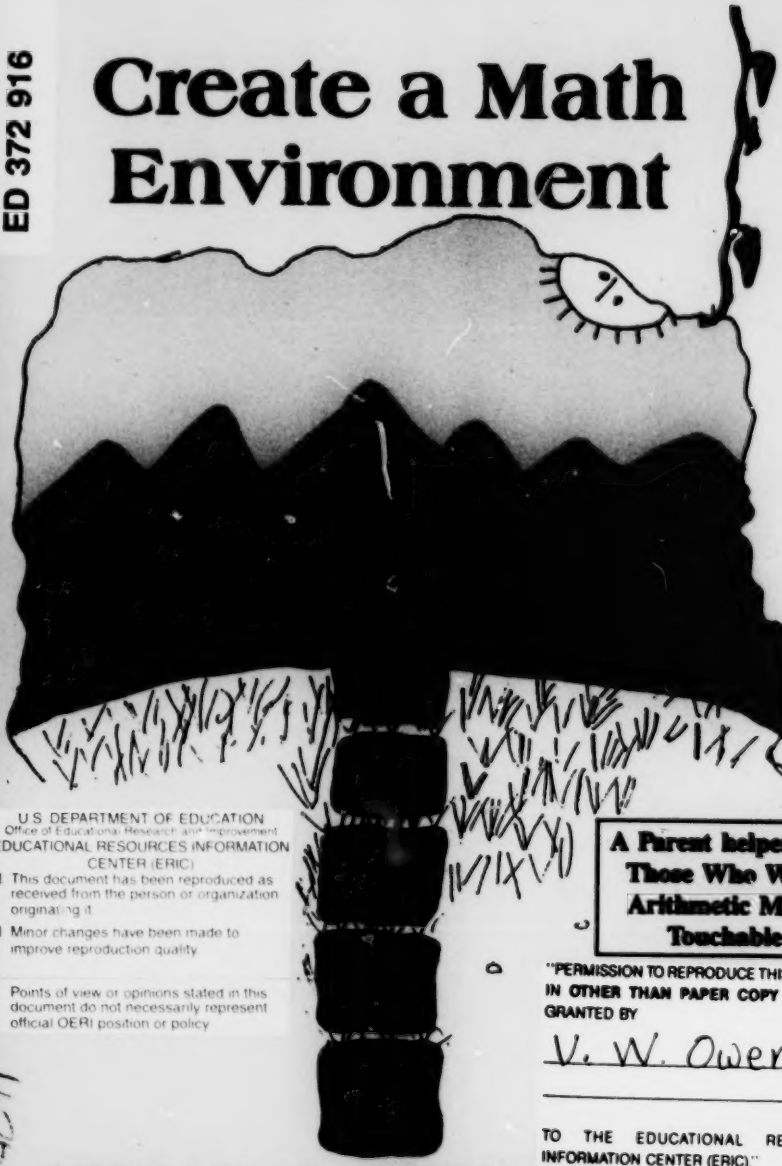
Create a Math Environment



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A Parent helper For Those Who Want Arithmetic Made Touchable

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CREATE A MATH ENVIRONMENT

A parent-helper book for those who want
Arithmetic made touchable.

By Vivian W. Owens

Illustrated by John Owens, III

First Edition

Eschar Publications, Waynesboro, Virginia

Create A Math Environment

A Parent-helper book for those who want
ARITHMETIC MADE TOUCHABLE.

By Vivian W. Owens

Published by:

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Cover design by John Owens, III

Dedication

This book is dedicated to my father, Reverend Charles Williams, Jr., and my mother, Essie Mae Williams, who first created a mathematical environment for me.

Acknowledgements

My son, John, turned 13 years old in January, 1992, nearly one year after he began drawing the illustrations for this book. He remained diligent in his efforts, patient with my revisions, and imaginative in his creations. I deeply appreciate the fortitude and time dedicated to this project.

Thanks also to my husband, John Owens, for his all-around help.

Create a Math Environment

Also written by Vivian Owens

PARENTING FOR EDUCATION

Preface

As a young mother, who also worked outside of her home, I felt a great desire for a math book that would allow me to teach my children basic mathematical concepts. I wanted a "show-me-how" book that would be as easy to use as a cook's recipe book. A guide to specific concepts and a suggestion of hands-on materials which would firmly assure understanding and learning seemed ideal.

Having taught junior high mathematics, I had encountered frustrations faced by learners because of their previous backgrounds. Lack of understanding of fundamental notions of whole numbers and fractions eroded their self confidence, and quite often it appeared that those who had played the least with toys or handled things least also held the least understanding. My task centered on refurbishing empty math storage tanks.

I hoped to avoid frustration math with my own children by making sure they received hands-on arithmetic from day one. Unfortunately, I could not find a book that satisfied needs I perceived of from a teacher's viewpoint while also satisfying the busy mother's need for ready-made, quick application ideas.

Consequently, I invented hands-on approaches to teach my children math concepts and prepared these a week in advance of their use and testing. Often, my children suggested a variation of an approach, and we ended up repeating their ideas. Many creations were born over the years.

Finally, I have organized and compiled these ideas for teaching mathematical concepts through touching objects. Arithmetic Made Touchable is the subtitle of this work. Hopefully, these ideas can be used by parents or by teachers.

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Shoebox Activities

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Introduction

"We shape our dwellings, and afterwards our dwellings shape us." Winston Churchill

What does the math environment look like? What does it feel like? What does it sound like? Are those questions you ponder as you reflect upon the title of this book, **CREATE A MATH ENVIRONMENT?**

Descriptions of the math environment will vary among homes, but they can all be characterized by some basic elements. Attitudes will be open, flexible, tolerant, and caring. Education and sound learning are valued. Joyful sounds emanate from its walls, for activities will be fun and creative. Seldom does the math environment look the same for a baby as for a thirteen year old, unless they live in the same home. Building blocks adorn kitchen shelves or book shelves and counting frames occupy centerpiece on dining tables, if babies and young children reside. Magnetic numbers stick to refrigerators and number concept drawings hang in a four year old's bedroom. One corner of a family room may support a table laid out with wooden geometric models, plastic red rulers, gallon milk jugs, quart bottles, toy clocks, play money, checkers and other math oriented games, and math related books.

Towel floor mats in a seven year old's bedroom may show north-south, east-west directions. A thirteen year old's family room may wall a blackboard bearing sets of equivalent frac-

tions or algebra problem practices. Manipulatives are in sight, in reach, ready to be touched and learned from at any moment the learner chooses. If you have shown him how to solve a particular problem using a designated group of objects, he can later, on his own, return to pick up these objects and further process this idea.

The math environment is relaxed. Stress, hurriedness, bad tempers, grumpy moods, and arrogance have no place in this scheme. Good will, good spirit, and cooperative adventure reign supreme.

CREATE A MATH ENVIRONMENT is a suppportive apparatus, intended to introduce mathematical concepts in the home and to produce familiarity before it is studied in depth in a formal structure; it may act as reinforcement after a concept has already been taught. Based on expected use, the ideas presented here are beginning level concepts. Each could appear at a higher level, but the author's purpose is to reach foundation learning, to suggest that if a learner fully grasps this presentation, then higher order thinking for more advanced problems will come easily. All activities seek to foster within the child a like for math and a readiness to deal with it at present and in the future.

Four major areas received concentration--whole numbers, fractions, decimals, and basic geometry--throughout the book. Various concepts from each lend to discovery activities, word problems, construction projects, and computational practice. Mixed and mingled within each section, concept presentation is designed to allow focus on a singular idea for ten or more

minutes, permitting touch and play manipulation while cognitively assessing root principles.

The opening pages explain how to use the book effectively. It is a mini lesson on why it is important to have a tutorial relationship with our children and an explanation of how best to obtain that relationship.

Section One is the heart of the how-to aspect of this book. Here, you find the activities to teach specific concepts within a manageable time period. A busy parent will turn to a page and gain quick understanding of the objective. Materials are listed and sometimes a diagram illustrates procedure. A discussion guide is offered to assist in preparing dialogue that will lead to verbal and computational understanding. Although this section particularly eases the parent's tasks, some leeway is left for the parent to modify and add-on or subtract-from many activities. In a number of cases, a child can carry on given activities with relatively little assistance from the parent.

Section Two is a fun section. Who can resist a twist in a problem or a nonsensical element that is not so nonsensical, altering the everyday sense of a problem? Challenging the child to think and look for reasons or patterns, these puzzles awaken any dormant intellect and enlivens an already active intellect. As these are presented without suggestion of how to make ideas touchable, it is left to the parent to decide whether manipulatives should be used, diagrams drawn, or entirely left to the child's own devices.

Section Three aligns very closely with Section Two. These are word problems presented in the form of stories, but they

will require nearly the same skills as "Quickies," as the child arrives at solutions. No tricks under the sleeve.

Section Four calls for applying skills and knowledge already gained. It calls upon higher thinking skills and imagination. The parent will want to stay in the background and serve as prodder in order to bring the child to maximum potential.

If everyday chores or involvements have benefits related to math, Section Five looks for them. "Reinforcers" is a section of what-to-do ideas that offer no explanation or craft plan.

CREATE A MATH ENVIORNMENT is an encouragement to make math activities and math visuals a part of the normal course of everyday living.

"What" and "how" ideas for this book are organized around three guiding principles:

(1) See it, feel it, and you will explore it further. The further you explore, the further you understand. When it becomes necessary for the learner to move from the concrete to the abstract, he will have built up the necessary skills.

(2) Repeat it and retain it. Repetition develops familiarity and remembrance for the small details that add up to the big picture.

(3) Talk math. Math has a language, and the child needs this language in order to express his observations, perceptions, and understanding of the world he occupies. Through dialogue and give-take discussions he brings his perceptions from the concrete to the abstract eventually. He learns to formulate ideas and questions about ideas.

In a math environment, many influences and surrounding conditions affect the growth of learner understanding and

comfort. This environment should have a bridge linking his home environment to the outside world. Skills and motivations developed in the home allow self confidence and competence to envelop progress toward lifelong learning.

To committ to creating a math environment, you are offering your child access to excellence.

How To Use Create A Math Environment Effectively

Reflect Upon Your Role As Parent-Teacher

You are your child's first and most important teacher. You can shape a very nurturing, positive atmosphere for learning. Chances are that you have a greater interest in your child and a greater concern for his total welfare than anyone else, and this alone makes you a desirable teacher for him.

Once you committ to creating a math environment, you actively enter a tutorial relationship with your child. Your tutoring is mostly informal and very casual, but highly targeted. It is a one-on-one relationship designed to benefit the child.

Reflect upon good attitudes and math skills you possess that can be shared.

Strive For a Good Tutorial Relationship

The tutorial relationship is an on-going relationship which affects the total person. Building a warm comfort zone, setting time aside consistently, planning and preparation, and an on-going awareness of needs are some elements required to set the stage for a good tutorial relationship.

Good tutorial relationships favor situations where good communication already exists. Love, trust, respect, and cooperation weigh heavily. Even if the parent adores the child but feels uncertain about his ability to teach, prospects for tutoring look good. Good possibility also exists for the parent who is now distant but wants to be involved.

How To Use Create A Math Environment Effectively

When parents act as teachers they bring an emotional element into an intellectual framework. This can be good if motivations center on what's best and good for the learner. Nurturing and caring can elevate self confidence in any learning situation. As the tutorial venture develops parents gain some objectivity and move the child forward.

Examine Your Awareness of Your Child

You probably know how your child looks, how much sleep he needs, and what he likes to eat. It is desirable now that you take a closer, honest view. In studying him, you discover how best to nurture his unique educational needs.

What are Karen's strength's? Is she verbally slow? Does she have trouble manipulating objects? Can she visualize ideas? When she writes, are the numbers turned backward and poorly formed? How far can she count?

You may be examining your awareness of an eighteen month old child. What do you need to know about her? At a time when she is rested, how well does she listen to you? Does she maintain eye contact with you while you are talking?

You have a second grader. When was the last time you had a conference with his teacher? Did she point out areas needing improvement?

If you are educating your child at home exclusively, study his self motivation and self starting skills. How interested is he in number matters? Regardless of the child's age and your situation, attempt to increase your awareness of your child.

Create a Math Environment

Assess Learner Readiness

How do you know whether a four year old is capable of learning multiplication? Is your two year old ready to count? Can the eleven year old be expected to use exponents correctly?

The answer lies in your judgment of readiness. Previous exposure, prior foundation and skills, and other prerequisite knowledge possessed by the learner guide you to some extent. Watch for signals like eagerness to learn, curiosity, and detail questioning when strong interest and potential readiness are present; and watch for blank stares, listlessness, fidgeting, low attention span, wandering eyes, easy distraction and other similar characteristics, if nonreadiness prevails. Readiness will be unique for each concept of math the learner faces.

Children are ready to handle a concept at some degree of ease in different stages of their development. You will have to determine whether your child is ready and how far to go. Age is not the only factor in this decision. Personality and temperament, language capabilities, manipulative capabilities, attention span, general intelligence, and attitude all play significant roles in assessing learner readiness for a concept.

Set Realistic, Clear Goals

What is the desired outcome? Keep in mind that one advantage of parent help at home is your awareness that your learner is a unique individual. You want to strengthen her weakness and allow her time to grow and develop mathematically without stress, without grade struggle, and without other limitations.

How To Use Create A Math Environment Effectively

You want to avoid labeling in your parental role. If Robert does not understand your lesson on adding fractions the first time around, this does not mean that he is stupid or that he is a slow learner. Many bright, honor students take longer to finish problems than others who are less capable. True learning should never be a quest to see how fast one completes problems or a competition to finish first.

On the other hand, the parent wants to avoid labeling Elizabeth as a genius because she quickly learned place value. Even the gifted child learns some concepts more easily than he learns others. All students need proper consideration for their particular needs. Learning takes time. Absorption is not always sponge-like. Strategies of teaching must often vary with each learner. If you are teaching Elizabeth how to recognize multiples of 2 by looking at the last digit, and she becomes confused, stop and start over. Use a different strategy.

Plan the activities you intend to pursue. One concept per day during one sitting is a good, realistic goal to start.

Provide Place And Materials

To carry out your teaching goals more easily and to make arithmetic forms more visible, set up a math center. A math center can be a box of material and equipment set aside in a specific location to be used for math activities or it can be a table laid out with materials and equipment. It can be a shelf (or shelves) of materials and equipment. The purpose of the math center is to provide things for you and your child to work with which will clearly explain an operation like addition or any other concept.

Create a Math Environment

What goes in the math center depends on how much you want to create for yourself and how much you want to purchase. Homemade materials are just as effective as store-bought. A combination works best. Look at the materials list in the appendix of this book. Also consult **PARENTING FOR EDUCATION** (Eschar Publications, 1989).

Decide On The Amount Of Time You Have To Spend

Time is important to the math environment. However, you do not need to spend big blocks of time on a given objective always. Ten minutes, concentrated on a specific learning task, can be very effective with lasting retention. Big blocks of time should only be planned for older children. Consistency, whether daily or weekly, is the key factor. Planning ahead allows better use of time.

Use Some Ideas From All Sections Of Book

No one expects you to skip-hop across these pages trying on ideas the way one tries on new outfits. With consistent use of all 5 approaches a child develops diffrent techniques for viewing a numbered world, and he also sees this as being his world and learns to be comfortable with it.

Consider These Findings

In a healthy, productive math environment, both parent and child must approach math joyously.

Learning is a fun pastime--a joyous game. Never equate it

with work.

Children perform better when the home stays in contact with the school.

Good attitudes fuel the student for good learning experiences.

Every child can experience success in math to some degree.

Home can provide math skills founded on practical situations. This improves the learner's attention and gives him a better attitude about his reasons for learning.

Seek outside help for your schoolaged child, if you realize that you are not equipped to teach him.

Parents can refresh their own math skills through using **CREATE A MATH ENVIRONMENT.**

Parents with math phobia should never voice their fears and anxiety to their growing learner. Express your best feelings and thoughts. Recount your moments of success.

Examine your math storage tank before you attempt to teach your child. Review your child's math textbook for a while, if you think you have forgotten those skills.

Before you begin a tutorial relationship with your child,

make sure you have good general communications with her.

Before you begin a tutorial relationship with your child, rid yourself of impatience, intolerance, quick temper, bad moods, grumpiness, and a tendency to use degrading words like "dummy."

The child begins to learn at birth.

When given the opportunity to learn young enough, all children learn more easily than adults.

Acquaint children with simple arithmetic as early as possible.

Do not force a child to sit while you try to teach him. Let him go if he is restless.

If your learner is ten years old and cannot count or add properly, teach him detail and use manipulatives. Get to the root of the problem. Was he never taught this basic skill or does he have a learning disability?

An older learner who did not process information or concepts correctly at an earlier age and is now experiencing failure because of it, can sometimes be rescued by receiving the same manipulative experience and rote practice and explanatory dialogue that younger children receive.

How To Use Create A Math Environment Effectively

Many children who do poorly in schools have never been exposed to concepts until they see them in textbooks.

Practice makes perfect. Rote computation is good for fast learners as well as slow learners.

Memory and remembrance are interwoven into learning.

Do not frown on memory. If multiplication facts have not been memorized they will not be useful to the child trying to carry out a division problem.

At some point you will be a homework helper for your child. Make sure you pinpoint her needs. Ask her what doesn't she understand. Show her how to solve the problem, then watch her solve several to convince you that she now understands.

Show your child how to use the textbook effectively.

Good reading skills are necessary for the good math student.

Make sure your child knows the meaning of math terms.

You will have fun playing with the ideas in **CREATE A MATH ENVIRONMENT.**

Create a Math Environment

Greek mathematics began in 6th century B.C. Euclid wrote ELEMENTS in 300 B.C. Apollonius wrote CONICS around 200 B.C.

Section 1

"Shoebox" Activities

"Shoebox" Math

"SHOEBOX" MATH is aptly named because this section resulted from a compilation of activities written on cards, which accumulated over the years, stored in several shoeboxes. These activities can be used to complement textbook learning, if a school-aged child has already been introduced to a concept, but it should not replace.

Although you may have five children, all in the proper age range for a shoebox math activity, individualize instruction. Give each child as much of your personal attention as possible.

Each presentation may be referred to continually. You are not a classroom teacher bent on covering one textbook in a year's time. You can spend as long and as often as is necessary on any one concept, until your child understands. In fact, repeating an activity is desirable.

"Shoebox" Activities

Age Appropriateness: 3 yrs. to 8 yrs.

EARLY MULTIPLICATION

CONCEPT STUDIED:

A set is a group of objects. Each object is called a member.

The number of sets multiplied by the number of members of each set is the same final number you get if you simply counted all the members together.

MATERIALS NEEDED:

2 red strings (8 inches, each); a square cardboard; 6 blue buttons (any bauble will do).

PROCEDURE:

Begin with the notion of two empty sets.

Objective: Multiply 2 x 3.

A. Lay out two rings (using 2 pieces of red string) on a square cardboard.
   * Ask child how many sets does he have.
B. Have child place 3 blue buttons inside each ring.
   * Ask child several questions about the number of buttons in each ring.

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C. Guide child in counting total number of buttons.
   * Ask how many there are.

D. Point out to child that he is looking at 2 sets.
   Each set has three members. Combined, there are six members from 2 sets.

E. Write down the equation.

   $2 \times 3 = 6$

   Say it aloud: "Two times three is six."

F. Change the number of buttons in the ring. Carry out same procedure. Use 3 or more examples, only changing number of buttons.

G. Change the number of red rings. Carry out same procedure from step A thru step F, recognizing the three rings instead of 2.

OBSERVATIONS TO NOTE:

In each step, bring child's attention to the number of sets or to the number of buttons.

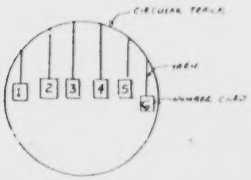
DISCUSSION:

Compare the empty sets with the sets having members.
Compare the symbolic representation of $2 \times 3 = 6$ with the "touch-feel and count" reality of 2 sets having 3 members each and combining to give a total of 6 members.
Encourage the child to explain to you why the number of rings can change or the number of members can change, but the principle of multiplication remains.

"Shoebox" Activities

Age Appropriateness: 3 yrs. to 8 yrs.

NUMBER ORDER



CONCEPT STUDIED:

Numbers can be arranged in increasing order.
Numbers can be arranged in decreasing order.

MATERIALS NEEDED:

Circular track made of coat hangers; varied colored card paper; strong yarn.

PROCEDURE:

Label cards with numbers and hang by yarn on wire rack. At start of lesson, number cards may be arrnaged in any order. Child is encouraged to move numbers around until he has achieved a left-to-right order of increasing numbers. After he has successfully completed this assignment by himself, you will decide whether he should continue this lesson by further arranging the numbers in a decreasing order.

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CONSIDERATIONS TO MAKE:

For the three to six year old, who may not have experienced concepts of number size and number comparisons before, you will need to permit the lesson to end with only one goal achieved. Avoid confusion of concepts. If the child of any age exhibits difficulty in carrying out the lesson, he will need more help in handling things until he sees clearly that six is indeed more than four.

DISCUSSION:

Counting order begins with the number one (1) and continues to infinity. Any number **said after** one is larger or greater than one.

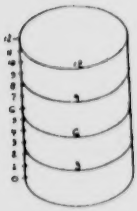
Any number greater than another is an **increase.**

To arrange numbers in **increasing order** means that you are going to set up **counting order** in a left-to-right manner. Number size gets larger.

"Shoebox" Activities

Age Appropriateness: 3 yrs. to 8 yrs.

FRAC-MEASURE



CONCEPT STUDIED:

Fraction means part of a whole. Whole means complete, all is there. The symbol "/" means "out of."

MATERIALS NEEDED:

1 clear plastic glass, red marking pen, tape measure, water.

PROCEDURE:

Measure the length of a glass. Divide the length by four. Mark off (in red) 3 lines on the glass according to equal portions and circle the top rim in red also.

Follow **EXAMPLE,** using a glass that measures 12 inches long.

EXAMPLE

(1) Your tape measure shows the glass to be 12 inches long.

(2) Divide 4 into 12:

(3) Count by 3 to 12: 3, 6, 9, 12

(4) On the glass, mark off 3 lines (in red) and circle the top rim.

(5) Label the lines with 3, 6, 9, 12:

(6) Pour in water. Fill to line 3.

a. Say to child, "This glass is one-fourth (1/4) full."
b. Pour to line 6 and say, "This glass is 1/2 full or 2/4 full."
c. To line 9, "...glass is 3/4 full."
d. To line 12, "...glass is completely full."

OBSERVATIONS TO NOTE:

For Preschooler:

Only consider marks--not numbers on marks--to show concept of 1/4 and 1/2.

For Schoolaged:

Note the length.

Specify the marked off parts.

DISCUSSION:

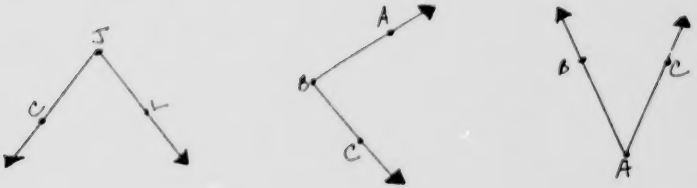
Explore the notion of fractions from an intuitive level. Review what is seen in terms of water level;indicate this with language of fractions. Bring observations to a written expression of fractions:

3/12 = 1/4 because 3+3+3+3 = 12
so 1 of 3's is 1/4.
6/12 = 1/2 because 6 + 6 = 12
so 1 of 6's is 1/2.
The slash symbol, "/," means "out of."

"Shoebox" Activities

Age Appropriateness: 6 Yrs. to 12 Yrs.

WHAT'S THE ANGLE?



CONCEPT STUDIED:

Angle measurement

MATERIALS NEEDED:

2 long pencils and a large sheet of white paper. A ruler and a protractor. Transparent tape.

PROCEDURE:

Tape white paper to table top under strong light source. Hold two pencils tip to tip forming an "L." Can you see the pencil's shadow on the paper?

Hold one pencil steady and move the other pencil closer to it. How does the angle look as shown by the shadow on the paper?

One person holds the pencils, while the other person draws.

Draw the lines made by the shadows. Use a protractor to measure the angles made by the shadows.

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OBSERVATIONS TO NOTE:

Compare the size of the shadow with the pencils.

What figures are formed?

What happens if you move the two pencils closer together? Farther apart?

DISCUSSION:

Describe the angles before measuring them. Are they large or small? Do right angles look like "L's"?

How can you change the size of an angle?

"Shoebox" Activities

Age Appropriateness: 2 yrs. to 8 yrs.

APPLE AND STEM

CONCEPT STUDIED:

One to one correspondence.

MATERIALS NEEDED:

Red and green construction paper, glue, and scissors.

PROCEDURE:

Cut out red apples from construction paper. Cut out green stems and attach to apples. Set up apples and discuss them. Talk about how real apples taste and feel. Ask child how many stems does a single apple have. Allow the child to identify that for every apple there is only one stem; point out this one-to-one relationship.

OBSERVATIONS TO NOTE:

How many apples are there? Where does a stem fit on an apple? How many stems does an average apple have?

Create a Math Environment

DISCUSSION:

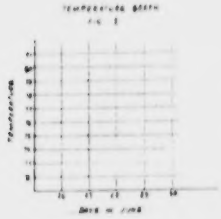
For every apple there is one stem as it is pulled from the tree. One-to-one correspondence shows you that numerical relationship which mates one object with another. Think of other one-to-one correspondence situations. Suggest that you look around in the home environment for good examples. Allow the child to identify plate and fork, shoe and foot, mouth and tongue, or pot and handle as objects that exhibit this concept.

On a different day you may want to set up 2 boxes and deposit 10 items in each. Allow the child to pull an item from box A and then pull a corresponding item from box B. Continue until all of the items from box A have been matched with an item from box B. Again, emphasize the meaning of one-on-one correspondence.

"Shoebox" Activities

Age Appropriateness: 5 yrs. to 12 yrs.

GRAPH TEMPERATURE



CONCEPT STUDIED:

A graph is a picture used to show data. Sometimes the picture looks like a set of points, and these points relate information about a particular condition. The bar, line, and circle are different kinds of graphs.

MATERIALS NEEDED:

A large sheet of white paper, tiny black construction dots, and glue.

PROCEDURE:

On the sheet of white paper, draw eleven horizontal lines (lines going across) and six vertical lines crossing them. Label the vertical scale "Temperature" and start at the lowest line to assign the number 72 and move upward, writing the following numbers: 73, 74, 75, 76, 77, 78, 79, 80, 81. Shown in figure 1.

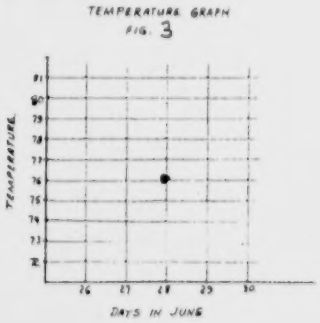
Create a Math Environment

Label the horizongal axis "June." Designate the following numbers across the horizontal axis: 26, 27, 28, 29, 30. See figure 2. You have just completed the mechanics of drawing the chart. Tape your chart to a wall or lay it on the floor for this activity.

Pretend with your child that you have collected temperature data over a five day period. Your information chart that you show her looks like this:

DAY	TEMPERATURE
June 26	72
June 27	74
June 28	76
June 29	77
June 30	78

Based on the information chart, you will graph. You will mark a point on figure 2 that pairs the temperature with the date. For example: On June 28 the temperature was 76 degrees. On your chart, you will show this:



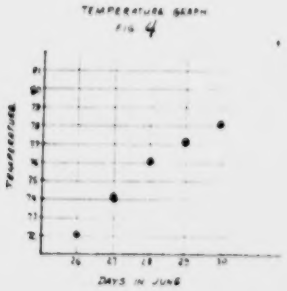
Locate June 28 along the horizontal axis and move upward until the vertical axis is labeled 76. Make a point with your pencil, then glue on a black dot.

Continue using your information chart to **plot** points on your graph. When you finish your graph will look like figure 4.

DISCUSSION:

At this point you do not want to weight the child down in too many terms and too much mechanics. Show her enough to understand that she is relating information by making points on a chart. this particular graph tells her that the temperature continued to rise with each succeeding day. Other data may show a drop in temperature. A picture of points results, and that picture might reveal a straight line or some type of curved line, if the points are connected.

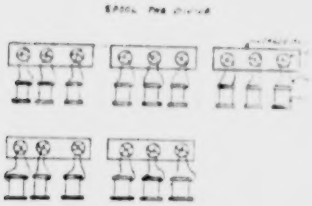
This is a kind of activity that might inspire a child to collect, tabulate, and graph her own information. If you have access to a computer, a child can spend hours of fun creating her own graphs.



Create a Math Environment

Age Appropriateness: 4 yrs. to 9 yrs.

SPOOL THE DIVIDE



CONCEPT STUDIED:

Division is an operation that separates things into parts. A set can be further subdivided (separated) into subsets. Each subset will have the same number of members.

MATERIALS NEEDED:

15 or more thread spools; 15 or more lengths of thread; 15 or more buttons; 5 or more five-inch strips of cardboard.

PROCEDURE:

Assemble cardboards with spools as follows: Secure three buttons to a 5-inch long strip of cardboard. The buttons may be sewn onto the cardboard with thread. Now, using thread, attach an empty thread spool to each button. Can you tape the cardboards to a table, so that the spools hang? Count all the spools. How many? Count all the boards. How many? Divide: How many spools hang on each board?

"Shoebox" Activities

OBSERVATIONS TO NOTE:

All of the spools counted together make up one set. The boards separate the spools into subsets. Because a certain number of spools hangs on each board, the boards divide the spools.

DISCUSSION:

Change the number of spools on a board. Change the number of boards. Allow the child to do the handling. Enter into conversation about how the process of counting the spools and separating them by hanging a specific amount on each board is actually a process of division.

After successful handling and understanding of the concept of division, introduce the language of division.

DIVISOR
DIVIDEND
QUOTIENT

If the child you're working with is schoolaged, use paper and pencil to describe the operation she has engaged in, using the spools and boards.

EXAMPLE:

3 spools hanging on each board

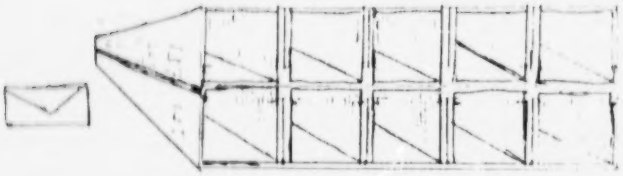
5 boards | 15 spools counted

*The paper processing should only occur following the spool activity.

Create a Math Environment

Age Appropriateness: 3 yrs. to 8 yrs.

POST OFFICE BOX DELIVERY



CONCEPT STUDIED:

Division is a process of separating things into parts. If a group of items is separated, the group is divided.

MATERIALS NEEDED:

10 shoeboxes, 20 envelopes, and 20 pieces of folded paper.

PROCEDURE:

Set up 10 boxes to serve as post office boxes. Tell the learner to select 10 envelopes and to divide those envelopes between the 10 mail boxes.

Show her to place 1 envelope into box at a time until she has completed task. Ask her how many envelopes are in each box. Select 20 envelopes and distribute them between 20 mail boxes. Vary the number of envelopes and boxes to yield quotients other than one.

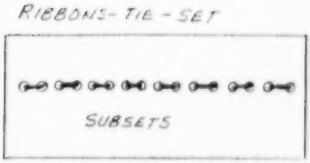
DISCUSSION:

Explain that the above procedure means that 10 envelopes divided by 10 mail boxes is 1. 20 envelopes divided by 20 mail boxes is 1. It is advisable to show several situations which yield a quotient of 1 in order to express the idea that any number divided by itself is 1. Play with other divisors to illustrate division.

Create a Math Environment

Age Appropriateness: School-aged

RIBBONS TIE



CONCEPT STUDIED:

Division is the process of separating a set into subsets.
If you have a set of 16 holes, can you separate these holes into 8 subsets?

MATERIALS NEEDED:

White cardboard, red ribbons, green ribbons.

PROCEDURE:

Punch 16 holes in white cardboard. From beneath cardboard, draw one ribbon through two holes and tie. Continue until all ribbons have been drawn through every hole.

DISCUSSION:

When you pull a ribbon through 2 holes, you are saying:

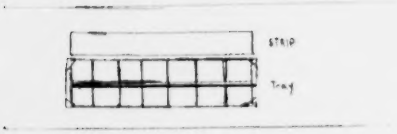
$16 \div 2$ or $2\overline{)16}$

because you are proceeding to tie off every two holes, until all 16 holes have been acted upon.

"Shoebox" Activities

Age Appropriateness: 4 yrs. to 8 yrs.

FROZEN FRACTIONS



CONCEPT STUDIED:

Fractions are numbers that tell how a part compares with a whole. A whole may be a group of items, a single item, or a region.

MATERIALS NEEDED:

Ice cube trays, water paint, brightly colored construction paper.

PROCEDURE:

Paint the center strip of an old ice cube tray. Cut a construction paper strip to fit over left side of tray. Show the learner that the construction paper strip also fits exactly over the right side of the tray.

DISCUSSION:

If the right side measures the same as the left side, the two sides are equal.

If two equal sides make up the whole ice cube tray, they are

called halves.

One half may be written "1/2" which means one part out of two.

FRACTION PRACTICE

Given the situations stated below, name and write (in numerical form) the associated fraction.

1. A blueberry pie is sliced into 8 equal parts. John eats two slices.

   Answer: 2 parts out of 8 parts; 8 parts make the whole.
   2/8 or two out of 8.
2. Twelve apples make up a fruit basket as sold by Foodley Fruits.

   Mary receives a basket and uses five apples to make tarts. Describe the portion of the basket used by Mary.
3. Twenty five popsicle sticks lay on the game table. Bobby and Jenny select fifteen for their game. What portion of the popsicle sticks did they select?

** Encourage the learner to make up her own problems similar to the ones above. Allow her to solve them with equal attention.

"Shoebox" Activities

Age Appropriateness: 3 yrs. to 8 yrs.

SLOSH, SLOSH, O' MY GOSH

CONCEPT STUDIED:

Subtraction is the process of taking away from.

MATERIALS NEEDED:

Large yellow pail of water, 6 ping pong balls, small yellow bucket, small blue bucket, small red bucket.

PROCEDURE:

Place six ping pong balls in the water. They will float along the surface. Ask the learner to: (1) Count the ping pong balls. (2) Pick up 2 balls. How many are left? Place those two balls in small yellow bucket. (3) Pick up 3. How many are left? Place those three in small blue bucket.

(4) Pick up 1. How many are left? Place that one in small red bucket. Bring buckets together. Count their contents. Dump their contents into large yellow pail. Count.

Create a Math Environment

DISCUSSION:

When the two ping pong balls were removed from the bucket of six, you were subtracting 2 from 6:

$$\begin{array}{r} 6 \\ -\,2 \\ \hline \end{array}$$

Talk your learner through this procedure.

When you take everything away, how many balls are left?

What number represents "nothing?"

The number zero signifies that all members have been removed from a set.

Using this same procedure, vary the number of balls placed in the water and removed from the bucket. Touch and dialogue will leave a vivid impression of the process of subtraction in the child's mind.

"Shoebox" Activities

Age Apprpriateness: Baby to School-aged

WHICH IS HEAVIER

CONCEPT STUDIED:

Given the mass of a cubic inch of lead and a cubic inch of wood, the lead feels heavier if you pick it up because of a property called density. The old puzzle, "Which is heavier a pound of feathers or a pound of lead?" catches many off-guard because, in general, people think of feathers as being lighter than lead, but a pound of anything compared to a pound of anything else shows sameness, not more or less. This activity is intended for general, intuitive prediction and discrimination. By feel, alone, can you decide which weighs more? This is not meant for exactness, specific units of measurement, or scales and balances.

MATERIALS NEEDED:

Feather, ping pong ball, cup, salt box.

PROCEDURE:

Arrange items so that your learner sees the following:

feather and ping pong ball
ping pong ball and cup
cup and salt box

Allow the learner to pick up one object at a time. Use the term "heavy" or "heavier" to show that you are comparing two given items. Ask the child to pick up any two objects and decide which is heavier.

For the older child, use a scale to show that the feeling of heavier can be translated into a numerical recording of weights.

DISCUSSION:

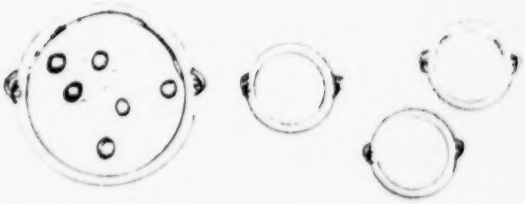
Enter into conversation with the child about comparing weights, using terms "heavy" or light.

Demonstrate, with other objects around your home, that size will not translate into heavy or light at all times. A large box may weigh less than a smaller size, 5-pound bag of sugar.

"Shoebox" Activities

Age Appropriateness: 3 yrs. to 8 yrs.

MAGNET MATH



CONCEPT STUDIED:

Addition of whole numbers.

MATERIALS NEEDED:

10 small magnets, magnetic boards, brightly colored paper tape, and marking pens.

PROCEDURE:

Set up magnetic boards (or any magnetic surfaces) to appear as window panes. Label six window panes from 1 to 6.

Place 1 magnet on pane 1. Place 2 magnets on pane 2. Place 3 magnets on pane 3.

Ask child "How many" magnets are there on all three panes:

(1) Let him count them.

(2) Talking aloud and pointing and touching, say, "One added to two is three. Add three more. The sum is six."

(3) On paper, show him: 1 + 2 + 3 = 6

Create a Math Environment

DISCUSSION:

Addition is a **"joining together"** operation. Use the other panes to join more magnets together.

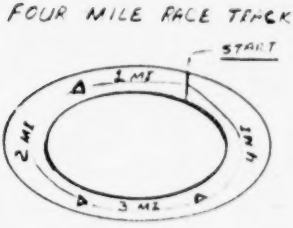
Emphasize how many you are starting off with and how many are "joining."

The word "sum" is important to define the result of the "joining together" process.

"Shoebox" Activities

Age Appropriateness: 3 yrs. to 10 yrs.

ARITHMETIC PROPORTION



CONCEPT STUDIED:

Arithmetic proportion means that one order of numbers changes in direct link to a second order of numbers. Set A is related to Set B according to a designed pattern. For example:

SET A	SET B
John claps his hands 10 times in	1 minute

This example shows a proportion of 10 to 1 or 10/1. This relationship between Set A and Set B, 10 to 1, is called a proportion. The problem can then be posed: If John claps his hands 20 times, how long will it take, since he is able to clap his hands 10 times in 1 minute?

MATERIALS NEEDED:

Posterboard strip--4" x 10", toy car, markers, toothpick, flags, clock or watch to designate time.

Create a Math Environment

PROCEDURE:

Move the car along the path at a steady rate. Post a flag at 2 mile intervals.

Pose the question: How far will the car travel in 3 hours, if it can go 2 miles in 1 hour?

Answer question by moving the car from one distance block to another, showing that the time change from one block to another is simply one hour.

PRACTICE PROBLEMS

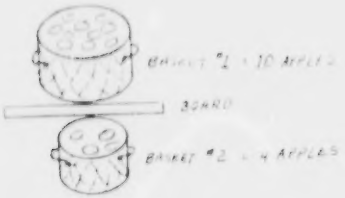
Read the following problems, think about each meaning, and then offer a solution by using the race track laid out already.

1) How far will the car travel in 4 hours, if it can go 2 miles in 1 hour?
2) How far will the car travel in 4 hours, if it can go 2 miles in 2 hours?
3) How far will the car travel in 12 hours, if it can go 2 miles in 2 hours?

"Shoebox" Activities

Age Appropriateness: 3 yrs. to 10 yrs.

BASKET RATIO



CONCEPT STUDIED:

"Ratio" is the concept of comparing one number to another. Usually, some relationship exists between one set of objects and another set of objects.

For example: For every 10 apples that fall off an apple tree, 4 apples remain attached to the tree. Write a ratio to describe the fallen apples compared to the unfallen. 10 to 4 or 10/4.

MATERIALS NEEDED:

2 small baskets, 20 similar small objects (like ping pong balls), and 1 board. Board can be cardboard or any stiff material.

PROCEDURE:

Position two baskets over one another, separated by a board. Place three objects in top basket and seven objects in lower basket. Compare numbers orally. Change number of objects in both baskets.

Create a Math Environment

DISCUSSION:

Talk over the notion of numbers relating to each other with your young learner. Talk of simple, every day comparisons:

(1) 1 hand has 5 fingers.

(2) 1 head has 2 eyes.

(3) 12 eggs have 12 yellow yolks.

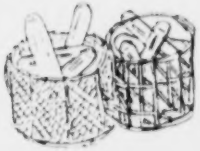
Offer comparison, by orally stating 1 to 5, 1 to 2, 12 to 12. Now, using hands-on explanation, place 1 object in top basket and 5 objects in lower basket.

Ask the young learner to compare the number of objects in the top basket to the number of objects in the second basket. Encourage him to say: "The **ratio** of the number of objects in the top basket to the number of objects in the lower basket is 1 to 5."

"Shoebox" Activities

Age Appropriateness: 3 yrs. to 12 yrs.

ADDITION PROPERTY OF ZERO



CONCEPT STUDIED:

The sum of any number and zero is that number. Zero means the complete absence of quantity; nothing.

MATERIALS NEEDED:

2 baskets, cucumbers

PROCEDURE:

This is a little skit. Two people will role play the characters, Jan and Julie, to achieve the following objective: Jan wants to combine the cucumbers she has grown in her garden with those Julie has grown in hers.

SKIT

Scene opens on Market Day. Jan and Julie arrive in the Market Square with baskets over their arms.

Jan: We can make more money with your supply **plus** mine. How many cucumbers do you have?

Julie: (Empties her basket, revealing there's nothing there): I have no cucumbers. None.

Jan: How many is that?

Julie: Zero. I have zero cucumbers.

Jan: When I add zero cucumbers to my basket, the number of cucumbers that I already have doesn't change.

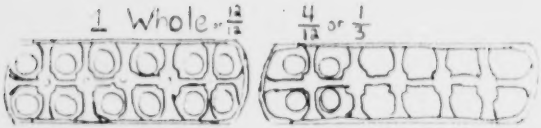
DISCUSSION:

Following the skit, consider different quantities that Jan may have held in her basket. What if she had 10 cucumbers in her basket? What is the sum of 10 and zero (10 to 0)? The answer is 10. Emphasize that whenever zero is added to a quantity, the quantity doesn't change.

"Shoebox" Activities

Age Appropriateness: 6 yrs. to 12 yrs.

MIXED NUMERALS



CONCEPT STUDIED:

A mixed numeral is a number like 5 2/3, showing the sum of a whole number and a fraction.

MATERIALS NEEDED:

Egg cartons, pretend eggs, writing pad and pen or chalkboard and chalk.

PROCEDURE:

Set up egg cartons with eggs to illustrate the mixed numeral concept. Represent full boxes to illustrate whole numbers and portions of boxes to show fractions.

DISCUSSION:

When you show fractions using portions of the egg cartons, first write the fractions as the number of eggs divided by 12: 4/12. Then move on to look at the structure of the egg carton. You can tape strips of colored paper across three portions to

illustrate the idea that if 4 eggs fill one section of the carton, it has filled 1/3 of the carton.

Use as many different combinations of numbers as possible to illustrate the idea that a mixed numeral represents the sum of a whole number and a fraction. The egg carton clearly represents 1/6, 1/4, 1/3, 1/2, 2/3, and other fractions.

Mixed numerals are often written to replace expanded numerals.

1 + 1/2 = 1 1/2
2 + 1/4 = 2 1/4
4 + 1/2 = 4 1/2
3 + 3/5 = 3 3/5
1 + 3/4 = 1 3/4

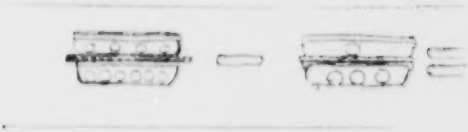
Mixed numerals are often written to replace improper fractions.

5/4 = 1 1/4
7/3 = 2 1/3
9/8 = 1 1/8
13/3 = 4 1/3
10/4 = 2 2/4

"Shoebox" Activities

Age Appropriateness: 8 yrs. to 12 yrs.

SUBTRACTION WITH DIFFERENT DENOMINATORS



CONCEPT STUDIED:

Fractions cannot be subtracted unless their denominators are the same.

MATERIALS NEEDED:

1 foot long plastic storage boxes, ping pong balls, cardboard plate, a minus sign on a prop, an equal sign on a prop, and a writing pad and pencil.

PROCEDURE:

Place 4 ping pong balls in a plastic storage box and place 6 ping pong balls in another plastic storage box. Slide a rectangular cardboard plate between them as the 4 balls rest above the 6 balls.

Place 1 ping pong ball in a plastic storage box and place 3 ping pong balls in another plastic storage box. Slide a rectangular cardboard plate between them, as the one ball rests above the three. Position the first set of boxes to the left on top of a table, place the propped minus sign, the second set of boxes, and the

propped equal sign. To the right of this set-up, station an empty box over an empty box.

You have set up a touchable, manipulable problem which says:

$$\frac{4}{6} - \frac{1}{3} = \frac{?}{?}$$

DISCUSSION:

Discuss situations of subtraction involving numbers that do not have the same denominators.

EXAMPLE: You want 1/3 of a cake, where there exists 1/2 of a cake. How do you take 1/3 from 1/2?

Instead of going directly to a solution by juggling the ping pong balls around or juggling the numbers around, concentrate on the fact that the fractions must have the same denominator. They get the same denominator by changing one or both fractions. How do you decide? Follow the procedure outlined below.

(1) Examine the denominators. Do they have any multiple in common? If yes, go to step 2.

(2) The smallest multiple for the two denominators will be the common denominator. What is the common denominator? If one of the present denominators is the common denominator, go to step 3.

(3) Change the second fraction, so that it shows the common denominator.

a) What number can you multiply the denominator by in order to get the common denominator? Show the common denominator.

b) Multiply the numerator by the same number you used in 3a.

c) What is the new fraction?

d) Adjust the second set of boxes (1 ping pong ball/3 ping pong balls) to show the new fraction: 2 ping pong balls on top, and 6 ping pong balls beneath.

(4) Carry through the subtraction process by only subtracting the numerators. For your ping pong balls this means, what is left if you take 2 ping pong balls from a set containing 4 ping pong balls?

To the right of the equal sign, place that number of balls in the empty top box (the numerator box).

No adjustment is necessary for the denominators, because common denominators always stay the same in the difference.

(5) In your empty box, you now have 2 ping pong balls over 6 ping pong balls. In other words, 4/6 - 1/3 =

4/6 - 2/6 = 2/6.

** It is not a good idea to reduce the fraction, 2/6, during this activity. Concentrate on the subtraction objective if you want to give the child the greatest benefit of the lesson.

Create a Math Environment

Age Appropriateness: 6 yrs. to 10 yrs.

WRITE A DECIMAL

CONCEPT STUDIED:

A decimal is a fraction whose denominator is a power of ten, when it is written with a decimal point.

MATERIALS NEEDED:

Chalkboard and chalk or writing pad and pencils.

PROCEDURE:

Write a fraction on the chalkboard. The fraction should have a power of ten in the denominator. The power of ten determines how many digits or places behind the decimal point the numeral will take up.

If the denominator is 10, the number will be written one place behind the decimal point (3/10 = 0.3).

If the denominator is 100, the number will occupy 2 places behind the decimal point (3/100 = 0.03).

If the denominator is 1000, the number will occupy 3 places behind the decimal point (45/1000 = 0.045).

In other words, the number of zeroes in the power of ten number tells you how many places to the right behind the decimal point, the number (which appears in the numerator) should occupy.

PROCEDURE:

Start off with fractions like 4/10, 9/10, 32/100, 16/100, 783/1000 and 27/1000 to show how to change from fraction to the decimal form.

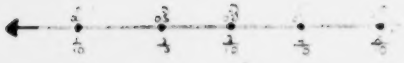
DISCUSSION:

When you write 4/10 = 0.4 or 9/10 = 0.9; or 32/100 = 0.32; or 16/100 = 0.16; or 783/1000 = 0.783, you will want to stress the number of zeroes in the power of ten denominator. Try as many examples as possible. Leave the learner to think of fractions he wants to change.

Create a Math Environment

Age Appropriateness: 6 yrs. to 10 yrs.

ADD DECIMALS



CONCEPT STUDIED:

Money amounts are usually written in decimal forms. Other quantities requiring exactness are also written in decimal form. Add decimal numbers by aligning the decimal points beneath each other. In aligning the decimal points, place values are also being aligned.

MATERIALS NEEDED:

Chalkboard and chalk or writing pad and pencil.

PROCEDURE:

Write several addition problems on the board. Point out that you have aligned the decimal points and have thereby placed the tenths under tenths, hundredths under hundredths, thousandths under thousandths, etc.

Carry out the additon as you would for whole numbers. Your answer (sum) will show the decimal point falling into place

under the decimal points of the addends. Carrying takes place for decimal numbers as with whole numbers.

DISCUSSION:

In a very informal, unplanned time, when the child has money in her hand, allow her to determine the amount by writing the quantities in a vertical column before adding.

Create a Math Environment

Age Appropriateness: 6 years thru 12 years

CHAIN MULTIPLES

CONCEPT STUDIED:

Consider two whole numbers called "a" and "m". If $m = a \cdot d$, then m is a multiple of a.

When a number like "a," is multiplied by another number and the result is a number, m, then m is called a multiple of a.

MATERIALS NEEDED:

Colorful chain of construction paper rings. Six chains having the following number of rings; 10, 15, 20, 25, 30, 40.

PROCEDURE:

Allow the child to count the number of rings in a given chain.

For example: Count 10 rings in one chain. Ask him to separate the rings in order to obtain 5 rings in each group.

Ask him does he have any left over?

How many groups does he have?

Explain that he is able to separate the rings into groups of five because 10 is a multiple of 5.

Continue to carry out this same procedure using 15, 20, 25, 30, and 40 rings.

DISCUSSION:

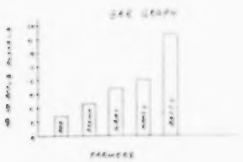
Encourage your learner to count by 5's. Write these numbers down and become familiar with their rote, consecutive sound. In carrying out the chain activity, use the term, "multiple of 5" to underscore that this number of items can be broken down into smaller groups that contain only 5 members.

Once this concept appears to be understood, carry out this same procedure with multiples of other numbers.

Create a Math Environment

Age Appropriateness: 6 years thru 10 years

BAR GRAPHS



CONCEPT STUDIED:

A bar graph is a quick way to visually compare data.

MATERIALS NEEDED:

Large sheet of white paper, green construction paper, glue, and pen.

PROCEDURE:

Make a table using the following information: At the local farmers' market, five farmers sold bushels of apples. Farmer Brown sold 7 bushels; Farmer Gray sold 10 bushels; Farmer Bob sold 4 bushels; Farmer Betty sold 22 bushels; and Farmer Nancy sold 12 bushels.

Draw a chart. Label the verticle axis "Number of Apple Bushels," and make a scale that goes from 0 to 24. Label the horizontal axis "Farmers." Designate each farmer by name along the scale.

Cut out vertical bars (strips of green construction paper) and glue them in place. Let 1 millimeter represent 1 bushel as you cut out the bars.

"Shoebox" Activities

DISCUSSION:

Study the bar graph with your learner. Compare data. Can he quickly look at the graph without even noticing numbers and say that Farmer Betty sold the most or that Farmer Bob sold the least?

What information can the learner ascertain without your prodding? Is there any information that he would like to convert to bar graph data?

Create a Math Environment

Age Appropriateness: 2 Years thru 6 Years

GEOMETRIC SPACE FIGURES

CONCEPT STUDIED:

Qualitative look at space figures. Space figures can be recognized easily. We speak of measuring their volumes. Volume is a measure of the inside (interior) of a space figure.

MATERIALS NEEDED:

Can of peaches, ice cream cone, a balloon, objects similar in appearance to each other listed already.

PROCEDURE:

Isolate the can of peaches. Use the term "cylinder" in describing its geometric figure. Point out the circles on the top and bottom, the curves of the can, and the parallel segments. Encourage the child to look for other like figures around the home. Talk about the space inside this can. How can this space be measured?

Isolate the ice cream cone. How much does it hold? What kind of measurements can you make of the cone? What can you say about its curves? How many circles does it have?

"Shoebox" Activities

Encourage the child to compare the ice cream cone with a funnel, megaphone, and dunce cap.

Isolate the balloon. The balloon is a good model of a sphere. Encourage the child to compare the shape of a basketball, globe, and rubber ball with that of a balloon. They are also spheres. Speak of volume or the measurement of the interior of the sphere.

DISCUSSION:

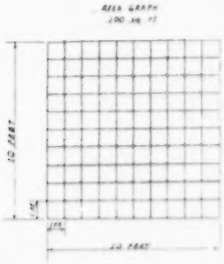
This is is a simple lesson in recognition of objects whose volumes are measured. If we see a balloon, we don't think of measuring its length. Nor do we attempt to measure the width of a funnel. For a can or wastebasket or sipping straw, we don't speak of its area.

Recognition in terms of "What is the shape?" or "Yes, I know how a sphere looks," is preliminary to concept development in actual measurement or formula usage. The mental image and the associated name are goals for this lesson.

Create a Math Environment

Age Appropriateness: 4 Years thru 10 Years

AREA OF A ROOM



CONCEPT STUDIED:

Area is the number of square units needed to cover a region.

MATERIALS NEEDED:

Square cut-outs that measure 1 inch on each side, 2 giant posterboards taped together, a square cardboard that measures 10 inches on each side, a rectangular cardboard that measures 10 inches in length and 2 inches in width.

PROCEDURE:

Lay a square cardboard on a table. Permit the young learner to place the square inch cut-outs over the surface of the cardboard, until all the surface is covered. Ask him how many did he use. The number of square inch units that he used is the area of that square.

Try using other size square cardboards and rectangular cardboards. After placing the square inch (cut-outs) units, always count how many.

"Shoebox" Activities

When the child is clear on how to measure the area of these cardboard surfaces, try cutting out about 100 square foot units. See how many square feet does any room in your house measure. For very small areas, like the surface of a book, measure based on square centimeters.

DISCUSSION:

For the older, school-aged child, you will want to relate this activity to a pencil and paper activity of **MULTIPLY LENGTH TIMES WIDTH TO OBTAIN AREA OF A REGION.** Use measuring tools to give true-to-life representation of area determinations.

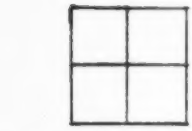
Square cut-outs can be conveniently packaged to allow the child to

find the area within your home of anything that interests her.

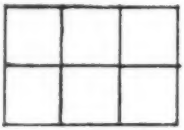
Create a Math Environment

Age Appropriateness: 4 Years thru 10 Years

SQUARE AREAS



$2 \times 2 = 2^2 = 4$



$2 \times 3 = 6$

CONCEPT STUDIED:

The number of square units that cover a region represents its area.

MATERIALS NEEDED:

Drawings like the ones above that show various areas of squares and rectangles. Drawings should depict the following measurements: 2x2; 2x3; 5x5; 5x6; 3x3; 3x4; and 4x9.

PROCEDURE:

Show the young learner which direction is length and which is width. Count the number of square units horizontally to tell length and the number of square units vertically that measure width. Represent the area measurement by saying and writing: "Two by two." And 2x2.

DISCUSSION:

Talk in terms of square units, how many square units in a given area, and length times width. A blank piece of paper can be

lain across a square or rectangle with its area called out. Have the child explain why a certain area is 25 square centimeters. Ask how many square units horizontally and how many units vertically would be shown, if the paper were removed.

Create a Math Environment

Age Appropriateness: 5 Years thru 12 Years

ALL IN ALL

CONCEPT STUDIED:

Addition is a shortcut method of counting.

Multiplication is a shortcut method of addition.

The same number of objects may be grouped together in several different ways.

MATERIALS NEEDED:

Felt board or flannel board in dark color, 36" flannel or felt to cover 24" x 32" piece of heavy cardboard. Pieces of colorful felt cut into shapes of lamps or any other form.

PROCEDURE:

Allow the child to place the felt lamps on the flannel board as shown above.

- Ask the child to count the number of lamps. How many? Write down the number.

"Shoebox" Activities

- Ask the child to determine how many objects are in each group if you look down a vertical column.
- Did she say "three (3)?" Good. Confirm with her that each group has the same number of objects.
- Using paper and pencil, show the learner that since the same number of objects is present in each group, the total number present may be represented through addition.

  $3 + 3 + 3 + 3 + 3 = 15$
- Also, point to each group in an additon process by adding aloud: "...three plus three equals six, plus three plus nine, plus three equals twelve, plus three equals fifteen."
- Ask the child to determine how many groups are represented on the board, if you look horizontally across the board.
- Did she say five (5)? Good. Confirm with her that each group has 3 objects.
- Using paper and pencil, show the learner that since there are 5 (vertical) groups with 3 objects in each group, that total may be represented by $5 \times 3 = 15$.

OBSERVATIONS TO NOTE:

The same number of objects has been represented in three different ways by the operations of counting, addition, and multiplication.

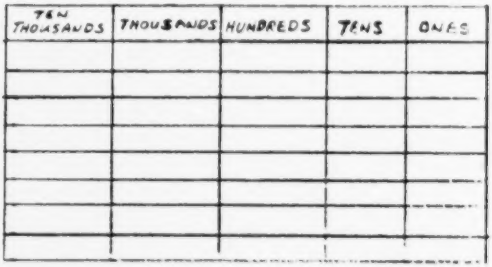
DISCUSSION:

Emphasize to the learner that she has several means of obtaining numerical information. Note how addition and multiplication are similar.

Create a Math Environment

Age Appropriateness: 6 Years thru 12 Years

PLACE VALUE FOR WHOLE NUMBERS



CONCEPT STUDIED:

Each digit in a numeral has its own value based upon its place.

MATERIALS NEEDED:

Board, markers, cardboard placards.

PROCEDURE:

Lay out a backboard for place values similar to the one above. Assign place values of ones, tens, hundreds, thousands, and ten thousands.

On 6" x 2" cardboard strips, write the following numbers:

1) 5
2) 27
3) 342
4) 784
5) 6784
6) 26784

"Shoebox" Activities

Using each number, decide the place value that each digit within a given numeral occupies. Write the place value of each digit under the correct heading on the blackbord. For example: 3,259 is shown according to its place values, on the next page.

TEN THOUSANDS	THOUSANDS	HUNDREDS	TENS	ONES
	3	2	5	9

OBSERVATIONS TO NOTE:

When you use the backboard, place value evaluation for every number starts at the ones place:

1) If there is only one digit in a whole number, then that digit occupies the one's place.
2) Move from the far right in assigning place value and proceed to the left. Farthest right, the place value is ones.
3) Zero is always respected and treated as a digit. If it occupies a place, then it is recognized as belonging there. For example: 302 would be assigned place values as follows:

PLACE VALUE FOR WHOLE NUMBERS

TEN THOUSANDS	THOUSANDS	HUNDREDS	TENS	ONES
		3	0	2

The zero in 302 occupies the tens place.

4) Each place is ten times the value of the place to its immediate right.

DISCUSSION:

Talk with your learner about expanding the numeral. That is, look at the numeral as the sum of the **values represented** by each digit.

302 would look like this as an expanded numeral:

300 + 0 + 2

(3 x 100) + (0 x 10) + (2 x 1)

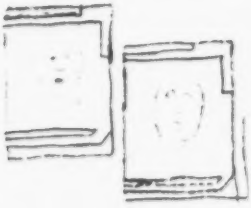
It is important for the learner to understand the value that each digit represents. When a child sees the 3 in 302, she should clearly see that the 3 represents how many hundreds the number contains.

In all discussions the child should be encouraged to ask questions and to explain terms and process.

"Shoebox" Activities

Age Appropriateness: 1 Year thru 6 Years

SIMPLE ADDITION



CONCEPT STUDIED:

Addition is the operation of joing together two or more sets of objects.

MATERIALS NEEDED:

Any collection of 20 similar objects. Individual serving cereal boxes, dish detergent bottles, toy blocks, toy cars, shoes, pencils, apples, and almost anything else will serve the purpose.

PROCEDURE:

On a table, place 2 dish detergent bottles a few inches away from 3 dish detergent bottles. Ask the learner to count the bottles, telling you how many are in each set. With this successfully completed, announce that you want to "add" the three bottles to the two bottles. Allow her to push the two sets together.

Ask her to count again, telling you how many are in the newly "joined" set.

Create a Math Environment

Using a different number of bottles, let your learner experience adding again, using different addends.

Using a different set of objects, go through the procedure of adding. This shows the learner that adding can take place with any set of objects and with any number of addends.

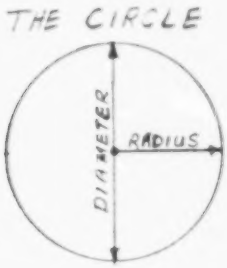
DISCUSSION:

Encourage the learner to use the word "add," but also satisfy the learner in understanding that addition results merely by joining two or more sets together.

"Shoebox" Activities

Age Appropriateness: 6 Years thru 12 Years

CIRCLE IN TERMS



CONCEPT STUDIED:

A circle is a simple closed curve, and all the points along the curve are an equal and fixed distance from the center.

A radius is the line segment that has one end point on the center of the circle and the other end point on the circle curve.

A diameter is a line segment that passes through the center of the circle. Two radii make up one diameter.

MATERIALS NEEDED:

Cardboard rectangle 4" long, 2 sharpened pencils, 1 sheet of paper, 1 ruler, and string.

PROCEDURE:

Make 2 holes in the cardboard rectangle. Place a pencil in each hole. Position this apparatus over a sheet of paper which lies flat on a table or desk. While holding one pencil still, swing the other to the right, moving in a circle around the paper. Note that the pencil being held still makes the center point.

With a circle drawn, stretch a string across the middle of the

circle. Measure its length. Refer to this stretched string as the "diameter."

From the center of the circle, stretch a string to the rim of the circle. Measure its length. Compare its length to the "diameter." It should be 1/2 the length. Refer to this stretched string as the "radius."

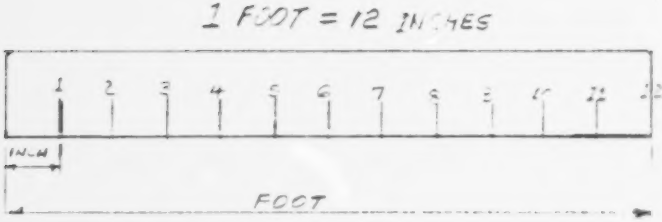
DISCUSSION:

Talk about circles by pointing out the center, radius, and diameter. Encourage the child to draw circles. Compare sizes of circles by visual inspection, followed by measuring their diameters.

"Shoebox" Activities

Age Appropriateness: 9 Years thru 12 Years

CHANGE INCHES TO FEET



CONCEPT STUDIED:

12 inches equals 1 foot. 1 foot equals 12 inches. Any multiple of 12 inches will show a like multiple of feet--given the original ratio.

MATERIALS NEEDED:

Toilet tissue rolls or paper towel roll or any handleable object that measures 12 inches long.

PROCEDURE:

Measure and mark off 12 inches on one side of a paper towel roll. Each marking represents one inch. Clearly show each succeeding inch. On other side color with navy blue. Write "1 foot" across this side in white lettering.

Flip from one side to the other. Dialogue says that each side of the paper towel roll (core) measures the same length as the other. **ONE SIDE IS EQUAL TO THE OTHER.**

Therefore, measurement shown on side A equals measurement shown on side B.

Tape another roll to existing one.

OBSERVATIONS TO NOTE:

Use string to stretch across length of both sides, showing equalness.

DISCUSSION:

What are the measurements on each side? Can we conclude that 12 inches is the same as 1 foot?

Can we conclude that 12 inches equals 1 foot?

If you add another roll (core), how many inches do you have?

How many feet do you have?

Continue adding rolls.

Tell me how to change inches into feet.

Make up a song to illustrate this relationship.

"Shoebox" Activities

Age Appropriateness: 3 Years thru 8 Years

FACTORS

CONCEPT STUDIED:

Call any three whole numbers X, Y, and Z. If you multiply X times Y to get Z, then X and Y are called factors of Z.

MATERIALS NEEDED:

Assorted colors of balls or any objects.

PROCEDURE:

Separate a group of 12 colorful balls into smaller groups of 3. Determine how many groups of 3. Discuss what factors are and that 3 and 4 are factors of 12.

Separate a group of 12 colorful balls into smaller groups of 6. Determine how many groups of 6. Discuss what factors are and that 6 and 2 are factors of 12.

DISCUSSION:

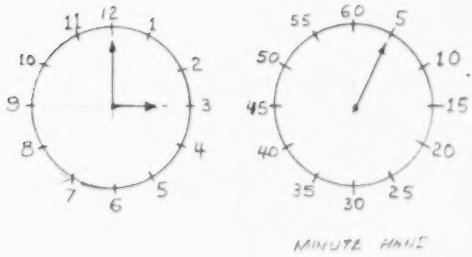
Use the term "factor" in working with school aged children. Even with preschool-aged children, "factor" can be used with-

out expectation of complete comprehension but with the hope of later recall. For the younger child, as well as with the school-aged, it is important just for him to play with a group of objects, rearranging them into various sized sets. Each set should have the same number of members.

"Shoebox" Activities

Age Appropriateness: 4 Years thru 12 Years

TELL TIME



CONCEPT STUDIED:

Time is measured by the hour.

Time is measured by the minute.

Every number on the clock's face represents a multiple of five if minutes are measured.

When the long hand points to a number, it is pointing to that number as representing a multiple of five, as told in minutes.

When the short hand points to a number that number measures the hour.

MATERIALS NEEDED:

Felt or flannel board, clock face made of construction paper having a small strip of coarse sandpaper glued to its back, pointer.

PROCEDURE:

Using the materials outlined above, arrange clock hands to show only on-the-hour times for 1 week or more. Allow the

child to move hands to various on-the-hour times. Let him teach you how four o'clock looks or how nine o'clock looks.

When you are confident that your learner knows how to recognize on-the-hour times, work with him on recognizing half hour times.

After several of these lessons, move to other quarter hour times.

Before teaching other time intervals, review counting by fives. Oral recitation of the counting by fives is helpful. Play the game described under "Time Game."

DISCUSSION:

This is a lesson best taught over a period of time. It is hard for a child to understand why time is read as "2:40" when the short hand points to 2 and the long hand points to 8, unless he understands that 8 x 5 is 40. For that reason, it usually works best to teach the child the multiples of 5 and then concentrate on associating the numbers (1 thru 11) with a multiple of 5.

After these lessons it may be important to teach the concept of the short hand being the hour hand and the long hand being the minute hand.

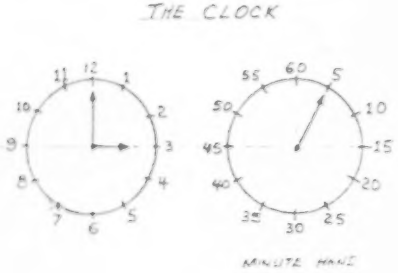
TIME GAME

Draw a clock's face on cardboard. Write the multiples of five as shown below on the clock's face. The minute hand can be made of a grocery store bag tie punched through from beneath. Cover each number with a bottle cap or a small

cardboard square. The bottle cap or cardboard square should be painted with the numbers 1 thru 12.

Game Play

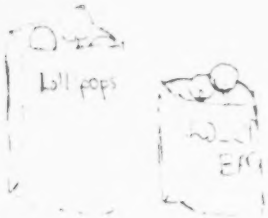
- Call out a multiple of 5.
- The child must remove the cover to reveal that number called.
- Continue calling out a multiple of 5 until all covers have been removed.
- Reward child with small prize--like a gold star or comic sticker.
- Play the game in reverse by calling the cover number and requesting the child to place it correctly over the multiple of five.



Create a Math Environment

Age Appropriateness: 2 Years thru 8 Years

MORE LOLLIPOPS



CONCEPT STUDIED:

Which bag contains more lollipops? Does bag A contain less than or more than bag B?

Concepts of greater than or less than can be measured in terms of counting order. If the amount of lollipops in bag B can be described by a counting number that is reached before the counting number of bag A, then bag B is less than bag A.

MATERIALS NEEDED:

15 lollipops, 2 empty bread bags, 4 clothes pins.

PROCEDURE:

Cut off the tops of 2 empty, clean bread bags. Place 4 lollipops in bag A and 9 lollipops in bag B. Hang both bags up with clothes pins.

Ask your young learner to look carefully at both bags. Which bag contains more?

Allow her to tell you how she determined which is greater.

DISCUSSION:

In this determination of greater than or less than, it is important to reserve any explanations or concept information until after the learner has made greater than/less than prediction. Allowing her to bring her intuitive judgment permits good development of mathematical intuitive skills without planting false concepts.

When she gives you her answer, you will want to confirm or correct her impressions, and you will want to explain how to compare size based on number of items present as determined by counting order.

Create a Math Environment

Age Appropriateness: 1 Year thru 6 Years

SIMPLE SUBTRACTION

CONCEPT STUDIED:

Subtraction is the act of taking things away.

Subtraction is the operation opposite of addition.

MATERIALS NEEDED:

Empty toilet tissue rolls (cores).

PROCEDURE:

Stand upright four (4) empty toilet tissue rolls (cores).

Allow the learner to count them in order to establish"how many."

Ask him to take away one and tell you how many are left.

Reset the original four.

Ask him to take away two and tell you how many are left.

Reset the original four and continue with the process until zero are left.

DISCUSSION:

Encourage dialogue with the child, explaining the meaning of

subtraction. Think of everyday examples where subtraction occurs. For the school-aged child, follow up this hands-on activity with a chalkboard illustration of subtraction problems that he carried out with the toilet tissue rolls.

Create a Math Environment

Age Appropriateness: 1 Year thru 6 Years

CEREAL SUBTRACTION

CONCEPT STUDIED:

Subtraction is the act of taking things away.

Amounts of things can be measured in a number of ways. How many? How much? The terms used in carrying out these measurements vary, but if subtraction is involved, the process has the same meaning.

MATERIALS NEEDED:

Box of cereal, measuring pitcher, measuring cups, empty, large bowl.

PROCEDURE:

Measure out the contents of a cereal box into a large bowl. Take out one (1) cup of cereal. Remeasure the amount left. Pour remaining contents back into cereal box. Give a visual analysis of the amount in the box. Is there more or less?

DISCUSSION:

Talk of "less" being a result of subtraction. Talk of "fewer"

items being left behind when any amount is removed.

Ask the child would it make any difference in the act of subtraction if you removed six ounces of cereal or one cup of cereal from a box as compared to removing one cup of grape juice from a juice pitcher.

Talk of simple acts of subtraction: Dan's chore is to fold 10 towels. After ten minues, he has folded six towels. How many more does he have to fold? How many towels did he remove from the stack of ten towels in ten minutes?

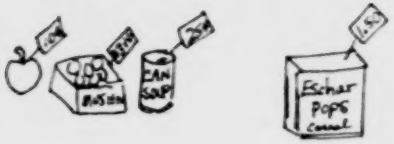
The bathtub is full of water. Cindy unplugs the tub and half of the water runs down the drain. How much water is left? Can you easily measure it quantitively or will your best estimate be in qualitative measure?

The toy box is full of toys. Baby throws handfuls of toys to the floor, leaving the box almost empty. Did baby subtract toys from the box?

Create a Math Environment

Age Appropriateness: 3 Years thru 10 Years

PLAY STORE



CONCEPT STUDIED:

Money can be added.

Group different coins together, add their values and you have a specific sum of money.

MATERIALS NEEDED:

$5 in coins, food boxes or any safe empty containers, and labels.

PROCEDURE:

Label each food box with prices. Price items using easily handled numbers. Use a toy cash register or pretend you are using one.

Go through the motion of shopping for food items. When child has completed purchases, you stand at the cash register and call out the prices. Write down the prices, and use the word "plus" as each item is registered. Show child the finished bill, and hand it to her for inspection.

DISCUSSION:

Talk with your child about the way a grocery bill is computed. Stress the addition of costs. At another time, you can vary this lesson by allowing the child to purchase 10 items of the same price. Here, you want to emphasize that multiplication is a short-cut method of addition.

Play of this game depends on the child's age and prior experience. A second or third grader playing this game will be able to understand decimal numbers to some extent, and you will be able to add the cost of a $2.59 t.v. dinner with a $4.03 box of detergent.

Use real money in order to teach money recognition. Of course, play money will teach the concept just as well.

Create a Math Environment

Age Appropriateness: 3 Years thru 10 Years

DOLLAR EXCHANGE MARKET

CONCEPT STUDIED:

Money values may be represented in different ways.

MATERIALS NEEDED:

Two dollar bills, 8 quarters, 20 dimes, 100 pennies, 40 nickels, 2 half dollars, 2 paper plates.

PROCEDURE:

Lay a one-dollar bill on a paper plate. On another paper plate, lay 4 quarters. You hold one plate; allow the child to hold the other plate.

Discuss the meaning of money exchange.

Go through the motion of handing the child your one-dollar bill on the paper plate in exchange for her placing in your hands the 4 quarters on the other paper plate.

Continue this type of dialogue and exchange for other dollar values. Smaller value exchanges are helpful and necessary.

"Shoebox" Activities

DISCUSSION:

Discuss with the child that a penny is worth 1 cent; a nickel is worth 5 cents; a dime is worth 10 cents. 25 cents is the value of a quarter, and a half dollar is 50 cents. The value of a dollar is 100 cents.

Talk about exchange for equal value. Always encourage your younger learner to contribute to the dialogue and to ask questions.

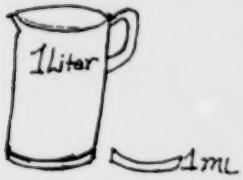
When there seems to be good general understanding of money exchange, talk about different situations of "how much money does Jimmy have if he saved 3 quarters, 2 dimes, and three dollar bills?"

Encourage children to pay for purchases in stores, even if you hand them money to pay for your goods. Allow young children as well as older children to make their own purchases with their own money whenever possible.

Create a Math Environment

Age Appropriateness: 5 Years thru 10 Years

POUR METRICS



CONCEPT STUDIED:

In the metric system, volume is measured in milliliters or liters.

MATERIALS NEEDED:

A plastic graduated cylinder (marked off in 1000 ml), a pitcher that holds exactly 1000 milliliters, paper cups, and other measuring cups or pitchers.

PROCEDURE:

Encourage the learner to play with the graduated cylinder. Note the milliliter markings. In pre-lesson activities she can pour 10 milliliters of water into a small paper cup or 50 milliliters of water into another cup. 500 milliliters of water into a pitcher will give her good contrast with the 10 ml in a small cup.

After preliminaries have satisified a development of notions of milliliters representing volume measurements, move on to show that it takes 1000 milliliters to make 1 liter.

"Shoebox" Activities

Label a 1-liter flask (or pitcher) with "1 Liter."
Pour water from the 1000 milliliter graduated cylinder into the 1-liter flask.

DISCUSSION:

The main discussion should focus on the concept that volume is measured in liters. The small unit for volume is the milliliter, and it takes 1000 milliliters to make 1 liter. Talk about liquid medicine being portioned off in milliliter units and gasoline being pumped in liters in European countries.
Orally, try the following practice problems with your learner.

PRACTICE PROBLEMS

5000 ml = ? liters
6000 ml = ? liters
8000 ml = ? liters
12000 ml = ? liters

23 liters = ? milliliters
50 liters = ? milliliters

ANSWERS TO PRACTICE PROBLEMS

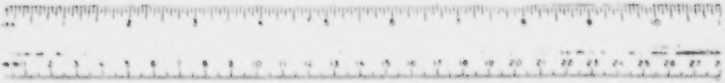
5000 ml = 5 liters
6000 ml = 6 liters
8000 ml = 8 liters
12000 ml = 12 liters

23 liters = 23000 milliliters
50 liters = 50000 milliliters

Create a Math Environment

Age Appropriateness: 5 Years thru 10 Years

METRIC MEASURES



CONCEPT STUDIED:

1000 millimeters equals 1 meter.

MATERIALS NEEDED:

An inexpensive piece of fabric that measures 1 meter long. A meter stick--leave one side showing 1000 millimeters, but cover the other side with white paper and write 1 meter in the center of it.

Other objects which you have determined to measure 1 meter.

PROCEDURE:

Encourage your learner to handle the metric ruler. Ask her to examine the markings on the 1000 millimeter side. Point out to her that the numbers 1 thru 100 which she observes represents centimeters. The multiples of 10 represent decimeters. You want her to note the markings that represent millimeters. Stretch a 1-meter length of inexpensive fabric across a table or wall. Tape it securely at the edges. Ask the child to use the

metric ruler to measure its length from the millimeter side (of the ruler).

Speak of the length as being "1000 millimeters."

Now measure the same fabric again, using the same ruler, but look at it from the side that reads "1 meter." Do flip-flops to emphasize that 1000 millimeters is the same as 1 meter. Measure other lengths that are exactly 1 meter long.

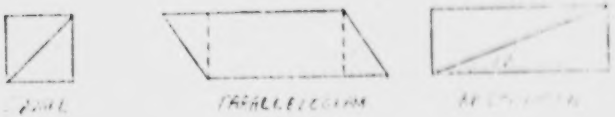
DISCUSSION:

Engage in dialogue that looks at how small is a millimeter; that it takes 1000 millimeters to make 1 meter. The millimeter is the smallest unit for measuring length in metric units.

Create a Math Environment

Age Appropriateness: 5 Years thru 10 Years

FIND TRIANGLES



CONCEPT STUDIED:

A triangle is an enclosed 3-sided figure, having 3 different angles. Sometimes it can be seen in four-sided figures, if lines are dropped along the midsection. Triangles can also be found in parallelograms, if lines are dotted along the sides to reveal an inner rectangle within the parallelogram.

MATERIALS NEEDED:

Drawing paper and pencil, scissors.

PROCEDURE:

Draw any rectangle, square, or parallelogram.

Draw a diagonal through a polygon.
Cut out the polygon.
Cut along the diagonal. What two figures remain?

DISCUSSION:

A diagonal cuts through the midsection of a square, rectangle,

and parallelogram. It is a line segment drawn from one corner point to another, without being a side of the plane figure that it cuts through.

Two triangles can be seen immediately if you cut along the diagonal.

Create a Math Environment

Age Appropriateness: 4 Years thru 12 years

BICYCLE CIRCLE

CONCEPT STUDIED:

A circle is the geometric figure that results from connecting a set of points. All the points are the same distance from a specific point A.

MATERIALS NEEDED:

Metric ruler, paper, pipe stem cleaners.

PROCEDURE:

Draw and label point A.

Use your ruler to draw 6 more points, each drawn 2 cm away from point A. Draw an arc from one point to the other. Bend the pipe stem cleaner so that it winds around your points. Clip it. Do you have a circle.

DISCUSSION:

Talk about circles. Conduct a cursory investigation of your

home to determine how many circles you find. Be sure to note the stick-up deodorizers and the lid on a mayonnaise jar.

Encourage your young learner to observe that: the circle is round, has a center, and its points on the outer rim of the circle are the same distance from the center.

Liken the circle to a bicycle wheel. Note the center. Note that all the spokes extend from the center. If you have a bicycle on hand, help the child to measure the distance from the center to the outer rim.

Create a Math Environment

Age Appropriateness: 2 Years thru 12 Years

CHANGE GAME

CONCEPT STUDIED:

Quantities bearing different names have the same value. They can be exchanged for one another, if the proper amount of one is given to replace the other.

MATERIALS NEEDED:

Two quart bottles and 1 gallon jug. Green colored water. Funnel. 100 pennies and 10 dimes. A meter stick, masking tape, and markalot.

PROCEDURE:

Fill 2 quart bottles with green colored water. Allow the child to pour the water into a gallon jug. Encourage him to verbally note the exchange taking place. Count 100 pennies into 10 sets, each set holding 10 pennies. Observe with the learner that 10 pennies are equivalent to 1 dime. Therefore, 1 dime may be exchanged for 10 pennies. After exchanges are made for each set, 10 dimes can be counted.

Holding a metric ruler, point out the millimeters and the centi-

meters. Observe that there are 100 centimeters labeled on the metric ruler.

The metric stick itself represents just 1 meter. Tape yellow paper to the unlabeled side of the meter stick and write "1 meter" in bold, black lettering. Note that 100 centimeters can be exchanged for 1 meter, since 1 side of the meter stick clearly shows 100 centimeters and the other side clearly shows 1 meter.

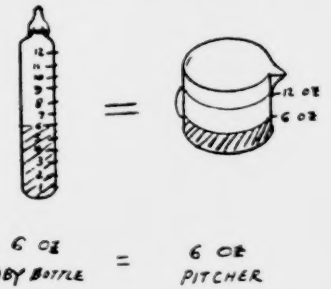
DISCUSSION:

Talk about the value of being able to exchange. Talk about simple exchange values and how they are useful in daily living.

Create a Math Environment

Age Appropriateness: 3 Years thru 10 Years

ONE HALF EQUALS FIVE TENTHS



CONCEPT STUDIED:

Equal measurements may appear in different containers.

MATERIALS NEEDED:

Baby's bottle measured off in ounces and a pitcher measured off in ounces. Red food coloring.

PROCEDURE:

Color water with red food coloring. Pour water into baby's bottle, measuring to one-half the bottle's capacity as given by numerical units. For example, if you have a 16 ounce bottle, then measure in 8 ounces of water. Now, pour this amount into a differently shaped container, which might also reveal this to be 8 ounces.

DISCUSSION:

Sixteen ounces (16 oz) equals sixteen ounces. A sixteen ounce bottle of apple juice can be poured into a 16 oz. bowl and fill it.

"Shoebox" Activities

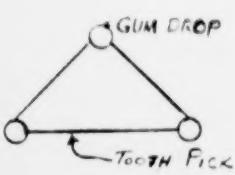
Containers may be shaped differently but they can hold the same amount.

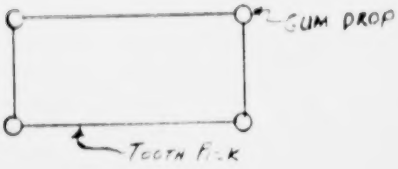
A pound of chocolate candy reads "1-lb" when placed on a scale balance. Similarly, a pound of carrots reads "1-lb" when placed on a scale balance. Ask the learner to distinguish between the appearance of these things, but to take note of the readings on the balance.

Create a Math Environment

Age Appropriateness: 4 Years thru 12 Years

GEOMETRIC FIGURES





CONCEPT STUDIED:

Geometric figures are given names based upon the number of sides possessed, angle measurements and other information that relates to shape.

MATERIALS NEEDED:

1 box of toothpicks, 1 bag of gumdrops or other kind of filler (styrofoam peanuts, etc.).

PROCEDURE:

Construct a triangle and a rectangle, using toothpicks and gumdrops. Allow the learner to pierce 3 gumdrops with 3 toothpicks and join them together. For the rectangle, allow the learner to choose and form a rectangle.

DISCUSSION:

Before construction begins, talk about a triangle being a 3-

sided polygon. That it is a closed figure. Some triangles have equal angle measurements; in some, only two angles are equal. In the scalene triangle, none of the angles have the same measurement.

After construction, encourage the learner to describe the sides and angles that she sees.

Before construction of the rectangle, point out that it is also a closed figure. Since it is a parallelogram with 4 right angles, use 2 toothpicks to show the learner that a right angle looks like an "L." She will easily find 4 Ls in the figure to be constructed. Use toothpicks beforehand to show what is meant by "parallel" and "opposite."

After completion of the rectangle, the learner is ready to point out that the sides are parallel and opposite and that there are 4 right angles.

Create a Math Environment

Age Appropriateness: 3 Years thru 10 Years

CARDS MULTIPLY

CONCEPT STUDIED:

Multiplication is the process of adding one number to itself for a specified number of times.

MATERIALS NEEDED:

10 sheets of paper or cardboard, 50 or more playing cards, and tape.

PROCEDURE:

Tape 5 cards on each sheet (10 sheets of paper). Label each page 1...10.

Allow the learner to count all the cards on each sheet of paper.

Count all the cards from first page to page number 10.

Use terms "count by fives" and show that in counting by 5, you arrive at same number that accumulated from one page to another, and finally the accumulated value of pages 1 thru 10.

Show the schoolaged child in written form that $10 \times 5 = 50$.

Discuss multiplication tables and the need to memorize tables, if child is second or third grader.

Carry out this same procedure with 2 cards per page or 3 cards per page. Use 5 cards per page, but 7 pages will serve as a good illustration.

DISCUSSION:

Repeatedly, you want to illustrate that multiplication is a short-cut method of addition. Using x amount of cards per page allows you to count singly to get an accumulated amount--thus showing additon, or it allows you to count by fives (or other numbers) to gain an accumulated amount--thus showing multiplication.

Find other ways and other manipulatives to illustrate the principles of multiplication as outlined in the above procedure.

Create a Math Environment

Age Appropriateness: 8 Years thru 12 Years

RAYS AND LINES

CONCEPT STUDIED:

A ray is a set of points that goes on without ending in one direction. A ray is part of a line, having only one end point, and it extends indefinitely in one direction.

A line can be made up of 2 rays, each ray extending in a different direction.

MATERIALS NEEDED:

Knitting needles, punched out paper holes, and glue.

PROCEDURE:

Glue punched out paper holes to a knitting needle. Call this creation a "ray."

Discuss rays. Hold the ray in different directions. Make another ray. Hold it in a different direction. Hold the two rays together, each pointing in a different direction.

DISCUSSION:

Talk about points being locations in space. Stress that the dot is a way to represent the point. Jab at the air, showing where a point might be.

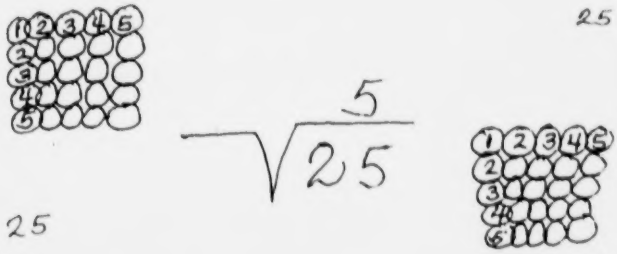
Look at any straight line construction, such as the top edge of a window frame and ask the learner to imagine that there are an infinite number of points along a path that moves to the left. That parade of points moving to the left is called a "ray." With chalk, mark off a ray on this window frame. Further, show that a ray can move to the right along the same path. The two rays together make up a line.

Look around a room and point out other rays and lines.

Create a Math Environment

Age Appropriateness: 6 Years thru 12 Years

5 IS THE SQUARE ROOT OF WHAT NUMBER



CONCEPT STUDIED:

If a number is multiplied by itself, the product produced is called "the square of the number."

Also, if a number is the product of a factor multiplied by itself, that factor is called "the square root" of the number.

If we call any number, X, then $X \cdot X = Y$ or $X^2 = Y$

MATERIALS NEEDED:

25 to 100 alphabet blocks. Paper and pencil.

PROCEDURE:

Spread out 25 blocks while sitting on the floor with your young learner. With you as guide and the child as the block handler, stack 5 blocks vertically and then come across and lay 5 blocks horizontally. Discuss the meaning of square as you go along. Continue to lay blocks until you have 5 across in 5 stacks. In other words, you have 25 blocks forming a square. Try this

same procedure using 6 blocks down and 6 blocks across, then complete the square.

DISCUSSION:

A square is the same length on all four sides. Every side measures the same. To determine the area of the square, count all of the blocks. You can also predict the area by multiplying the number of blocks down by the number of blocks across.

After you discuss what a square is, talk about the root of the square.

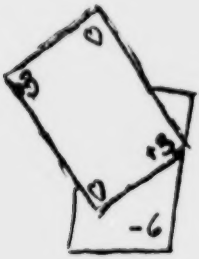
When you have a square made by square blocks, the "square root" is the number down or the number across.

A second activity to follow the above is carried out with paper and pencil: Draw a square. Mark off 5 blocks, going down. Mark off 5 blocks, going across. Make columns and rows according to the lines set up. Now count all the blocks together. How many?

Create a Math Environment

Age Appropriateness: 5 Years thru 12 Years

SIGN NUMBERS



CONCEPT STUDIED:

Integers. To show that a positive (+) sign in front of a number means a gain and a negative (-) sign in front of a number means a loss.

MATERIALS NEEDED:

50 3 x 3 cards, markalot.

PROCEDURE:

Write a number on each card. 25 cards should bear positive signed numbers--+5, +6, +1, +2, +4, +21, etc. The other 25 cards should bear negative signed numbers.

Play a game using these cards. 2 players needed. The object of the game will be to gain the most points. With 20 cards dealt to each player, the cards should be turned face down.

The player to the right starts the game. He picks up any two cards, shows his hand to his opponent, and adds the two numbers from the cards. The sum or difference that he gets is

recorded; and the other player goes through the same procedure.

When all cards have been used by each player, the total is calculated and a winner is declared for that round.

A new round of play begins. Continue for five rounds.

OBSERVATIONS TO NOTE:

What is the meaning of signed numbers? Emphasize how signed numbers are written. Read each number aloud.

DISCUSSION:

Make a table to show how the cards are read.

Can you describe some everyday common events using integers?

1) John spent $5. Answer: -5
2) Mr. Marner saved $200. Answer: +$200
3) The temperature dropped by 15 degrees. Answer: -15

FURTHER ACTIVITY:

Shuffleboard games for children are an excellent way to teach the meaning of integers.

BACKGROUND INFORMATION FOR ADDING SIGNED NUMBERS:

1. If two numbers have the same sign, add their absolute values and give the answer the common sign.

EXAMPLES: $+5 + +3 = +8$ $-5 + -3 = -8$

$+11 + +4 = +15$ $-11 + -3 = -14$

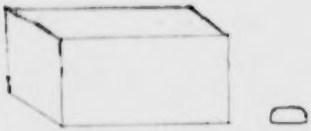
2. If two numbers have different signs, subtract their absolute values and give the answer the sign of the larger absolute value number.

EXAMPLES: $+5 + -3 = +2$ $-5 + +3 = -2$

"Shoebox" Activities

Age Appropriateness: 6 Years thru 13 Years

REMOVE THE PERCENT



CONCEPT STUDIED:

Percent means "how many out of 100." N items out of 100 itens is N%.

MATERIALS NEEDED:

100 deodorant container tops and a large box.

PROCEDURE:

Take out 25 items from a 100-item box. You have taken out 25%. Continue this activity with 35 items, 50 items, 75 items, and 82 items being removed.

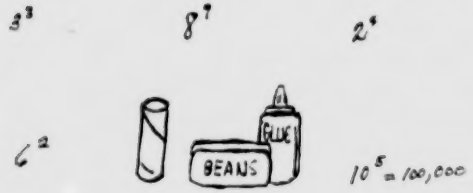
DISCUSSION:

As you take out 25 items, relate this to 25%. Write 25/100. Compare 25/100 to 1/4 and discuss the idea that sometimes you will not have 100 items, but you can still calculate percent.

Create a Math Environment

Age Appropriateness: 9 Years thru 13 Years

EXPONENTS



CONCEPT STUDIED:

Exponents are little numbers that appear to the right hand, above other numbers: 2^3, 3^2, 5^4, 6^2, 8^5.

2^3 is read "two to the third power" or "two raised to the power of 3."

The value of expression can be obtained by multiplying 2 by itself 3 times: $2 \times 2 \times 2 = 2 \times (2 \times 2)$

$= 2 \times (4)$

$= 8$

Powers of ten are a special case of exponents.

Ten is the base number and other numbers are used as exponents.

10^4 means ten multiplied by itself four times.

$10^4 = 10 \times 10 \times 10 \times 10 = 10\,000$

** Anytime 10 is raised to a specific power, the value of the expression is the number that contains 1 and the number of zeroes shown by the exponent. $10^4 = 10\,000$. Note the 4 zeroes in 10 000 being related to the exponent 4.

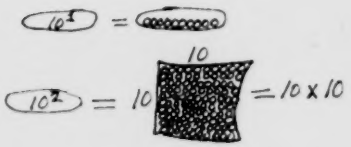
"Shoebox" Activities

MATERIALS NEEDED:

Toilet tissue cores, cardboard squares, and marking pens.

PROCEDURE:

Using toilet tissue cores, illustrate the equivalents of power of ten as shown below:



Slit open the toilet tissue core and glue on beans or round disks.

DISCUSSION:

When ten is written with a superscript, 10^3, etc. it means that ten is raised to the power indicated by the superscript. The superscript tells you to multiply ten by itself that number of times.

$$10^3 = 10 \times 10 \times 10$$
$$= 1000$$

Manipulatives yield good illustrations of exponent principles when the exponents are 2 or 3. Beyond 3 illustrations become more complicated. For example, in illustrating 10^5, you would need to arrange 10 cardboard squares or toilet tissue cores, each bearing 100 disks. The 100 disks would be arranged in a 10 down and 10 across column-row situation, showing that 10 is used as a multiplier twice ($10 \cdot 10 = 10^2$). In setting up 10 cardboard squares, you show 10 being used as a multiplier 3 times, $10 \times 10 \times 10 = 10 \times 10^2 = 10^3$.

Create a Math Environment

FURTHER PRACTICE

3^2 = _____ x _____

5^4 = _____ x _____ x _____ x _____

=

Evaluate the exponential expressions below. For the powers of 3 try using toilet tissue cores or cardboard squares with marking pens or disks.

(1) 2^4

(2) 3^3

(3) 3^6

(4) 5^3

(5) 7^4

Answers: (1) 16 (2) 27 (3) 729 (4) 125 (5) 2401

Section 2

"Quickies"

Create a Math Environment

Quickies

"QUICKIES" are word problems designed to be solved in a short period of time (around 10 minutes). They boggle or twist perception in a slightly teasing manner, and they require some reasoning and logic in reaching an acceptable solution.

My first use of the **"QUICKIE"** in the math classroom appeared nearly twenty years ago in answer to two needs. Students had a need to solve word problems more frequently and without recognizable textbook clues (i.e., word problems at the end of a chapter on subtraction of fractions). And I had a need to check attendance without checking class discipline at the same time. Hence, I started writing **"quickies"** on the board, so that students began pondering over them as soon as they entered the classroom. The only drawback was that the students developed an insatiable appetite for quickies; one per day was not enough.

I took this idea home to my two young daughters in the form of the "Breakfast Jogger." **QUICKIES** were written on index cards and placed in a cookie jar on the breakfast table. Before my three year old and six year old daughters ate breakfast, they were encouraged to jog their brains into action. Again, the problem was the insatiable appetites of my young learners.

Herewith, **"QUICKIES"** are presented for you to apply in the manner most appropriate for your situation. Most of the quickies on the following pages adhere to general notions of word problems and cannot be classified as tricky. Some require multi-step solutions, but most can be solved by young

learners between the ages of three and thirteen. Naturally, you will decide which problems require skill usage not yet encountered by the three or six year old. On the other hand, you may find that if you read a problem aloud to a four year old, she may possess math instincts which will guide her to an understandable solution. Her reasoning will be clear, sound, and comprehensible.

Some of the "**QUICKIES**" included here may require thirty minutes or more of thinking time. "**QUICKIES**" are not always solved quickly.

Create a Math Environment

1: GLORY AGE

Glory and Glamor are first cousins. Glamor is one and a half times older than Glory, but in five years Glory will be the age that Glamor is now. How old is each girl?

2: FRUIT BAGS

Three bags are labeled incorrectly. One bag contains two plums. One bag contains two apricots. One bag contains a plum and an apricot. The bags are labeled PA AA PP. If you look at just one piece of fruit in one of the bags, you will know how to correctly label all three bags. Explain.

3: GRASSHOPPER HOPS

Suppose a grasshopper is 16 centimeters away from an alfalfa leaf when she decides to hop up to it. The grasshopper is able to hop about 20 times as far as the length of her body. She hops half way to the leaf and stops before hopping again. She continues to hop half the distance from the place she last stopped. Will she reach the leaf before she dies? Show calculations to back up your answer.

Quickies

4: ADD THE PAIRS

Look at the counting numbers from one to eight: 1 2 3 4 5 6 7 8. Pair off these numbers, so that you have four sets. Add each number pair, arranging for each sum to be the same. Show your number pairs.

5: CENTURY PAIRS

Think of the multiples of 10, from 10 to 90: 10 20 30 40 50 60 70 80 90. Pair off these numbers, so that you have four sets. One number will be left out. Add each number pair to show the same sum. What is that sum? What are the number pairs?

6: THE HOT DOG CONTEST

Lew, John, and Beau went to the county fair. The three teenagers took on a contest dare to eat 60 hot dogs together. They decided to eat 20 hot dogs each. The contest judges changed their minds and said only 50 hot dogs needed to be eaten. John had already eaten 20 hot dogs when this decision came. Beau had eaten 8 hot dogs and Lew had eaten 10. How many more will each boy have to eat to even out the eating?

7: SQUARE TOOTHPICKS

How many squares can be formed from ten toothpicks? Toothpicks must touch end-to-end and they cannot be broken.

8: BEBEE AND THE PUPPY

Bebee played throw-the-ball with her little puppy. Every time she threw two balls, he brought back one. If Bebee threw 10 balls, how many did her puppy bring back to her?

9: TOY TRAVEL

Shea and Chad built electronic toy cars. They wanted to know which car was fastest. Chad's car started out ahead of Shea's and had traveled 200 feet before hers started. Chad's car travels 50 feet per minute. If Shea's car travels 60 feet per minute, how long will she require to overtake Chad?

Quickies

10: BUD AND SUSAN

Bud's grandmother is 84 years old and speaks two languages. Susan's grandmother is Bud's mother's sister's mother. She also speaks two languages. Susan is 12 times younger than her grandmother. How old is Susan's grandmother?

11: TRIANGLE TOOTHPICKS

If you have 21 toothpicks, can you make 7 triangles? Toothpicks can only touch end-to-end and they cannot be broken.

12: CAMEL CARAVANS

Arab camel caravans brought salt and copper from mines in the Sahara to Ghana around 300 A.D. If the Moroccan Berbers conquered Ghana in the mid 1000's, how old would a bag of salt have been at the time of conquer if it were the first bag brought in on the camel caravans?

Create a Math Environment

13: MONKEY SWINGS

The monkey swung from limb to limb, paying no attention to the warning sounds of his mates. Inorder to make it to complete safety he needed to swing through 15 consecutive limbs. At the 9th and 10th limbs, danger awaited him. How can he by-pass limbs 9 and 10 without dropping to the ground where other dangers wait?

14: FIBONACCI NUMBERS

Fibonacci Numbers follow a sequence named after the Italian mathematician, Leonardo Fibonacci. Study the sequence and see if you can figure out the next three numbers.

2, 3, 5, 8, 13, 21, 34, 55, ...

15: SQUARE THE FIBONACCI NUMBER

Look at any three Fibonacci Numbers. 2, 3, 5, for example. Mark the middle number and square it, then subtract the product of the numbers on each side of it.

$3^2 - 2 \times 5 = -1$

Try 3, 5, 8 or 8, 13, 21

What did you get?

Quickies

16: THE WATER FOWL BRIDGE

The Water Fowl Bridge was built especially for trains. One train that comes through weekly measures exactly one mile long, and the Water Fowl Bridge measures exactly one mile long. The train travels at a speed of 60 miles per hour.
If Wanda is sitting at the rear of the train, approximately how long will it take for her to cross the bridge?

17: PENNY AND THE PUZZLE KING

Penny met a puzzle king when she started off down the long trail home. She asked him what he had in his trailer of tricks. He showed her a mother kangaroo with 2 joeys; two bears with 4 cubs; three elephants with 6 calves; and four billy goats with 8 kids. How many were going off down the long trail home?

18: DECOMPOSE A SQUARE

Can 5^2 (five squre) be decomposed to form two smaller squares? Show your proof.

Create a Math Environment

19: ODDS AND PRIMES

11, 15, and 29 are odd numbers greater than 7. Can you rename them each, as the sum of 3 prime numbers?

20: SIT TALLER

Joe and Jeff are brothers. Jeff stands 12 inches taller than Joe, but Joe sits a foot shorter than Jeff. How can this be?

21: SACK OF BALLS?

Four basketballs will fit in the sack Coach Orr dragged across the court at the end of the big tournament game. Molly accidentally used the same sack for another game and fitted twenty balls into the same space. Is this possible?[2]

Quickies

22: WHO SAVED THE MOST?

Roy and Rhonda are ten year old twins. Their mother gave them a choice of saving plans with a local bank. Roy deposits $20 a week in the bank. Rhonda deposited $1 in the bank the first week, and each week she doubles the amount she deposited the previous week. At the end of 8 weeks, which child will have saved the most money?

23: CREAM AH ICE

Ice costs five cents more than cream. Together they cost eleven cents. How much does each cost?

24: UNUSUAL TIME TELLER

Orky was having a hard time telling time in the usual way. He asked Aunt Vera: "What time is it when it's sixty minutes til 5?"

25: THE ALLIGATOR'S TAIL

If an alligator, whose tail sweeps a 2 feet radius, tries to climb a 21 feet pole, he only moves 1/2 inch per half hour. How long will it take him to climb the pole?

Brain Teaser

Two mothers and two daughters went shopping. Each bought one dress. Strangely, only three dresses were bought. Can this be true?

Answer:

The two mothers and two daughters are actually only three people - a grandmother, her daughter, and her granddaughter.

Section 3

"Story Problems"

Story Problems

STORY PROBLEMS are a step below "Quickies" on a scale of hard to easy. These are problems related in the form of stories. Word problems that invite you to assemble information, think it through carefully, and reason to find a logical conclusion are the essence of this section.

Story Problems

1. Kangaroo jumped to the red line, then he jumped to the blue line. He jumped one foot, then he jumped three (3) feet. All together, how many feet did Kangaroo jump?

2. Kangaroo could carry 2 babies in her pouch at one time. A short
journey was being planned by all the mother kangaroos, and eight
babies needed transportation. Only 6 baby kangaroos could travel with their mothers. After Kangaroo carried her babies to Hopland, she returned for the babies who were left behind. Could she transport these babies in one trip, or would she need to make two trips?

3. Kary liked to play with boxes. One afternoon her mother gave her a bag full of red ribbons which were very long. Kary stretched a ribbon across the middle of each box, and a box looked like 2 triangles when Kary looked at it. Try doing this and see if your box looks like two triangles afterward.

4. On Betty's trip to Sea World, she watched the whales leap into the air and dive under water. One large whale leaped into the air six times. How many times did he dive under water?

5. Kuppy, the clown, leads a pack of elephants around the circus ring. In his red and white polka dot suit, Kuppy dances and prances in a zigzag movement between the parade of eleven elephants. When he reaches the middle, he jumps onto the middle elephant's back and stands up, raising his hands

high in the air. The crowd cheers loudly for his performance. All of the elephants then leave the ring. Which elephant number does he stand upon for his finale?

6. 10,000 years ago Indians lived in Florida. Some were hunters and fishermen, and others were farmers as well as hunters. They had settled the land long before any other people invaded. The Spanish first invaded in 1513 when Ponce De Leon claimed the region for Spain. In 1821, Florida came under control of the U.S. government; and the government wanted the Seminole Indians to leave and relocate in Oklahoma, because the Seminoles lived on some of the territory's richest farmland.
What was the length of time between the Spanish claiming Florida and the take-over by the U.S. government?

7. Jeff and Susan built a boat out of logs. They sawed and cut for a long time. When they measured the length of the boat, it was 8 feet long. When they pushed it to the river, two feet of it were hidden by tall water plants. What length of it could an onlooker see?

8. If you live along the Massachusetts coast, you have probably seen a fulmar perched on rocky cliffs, where it builds its nest. These birds like to follow whaling boats because they feed on whale blubber. If 60 fulmars can eat one pound of whale blubber in a one week period, how long would it take 60 fulmars to eat 3 pounds of whale blubber?

Story Problems

9. April's bag of coins was accidentally left on the school's playground. The caretaker found the coins, but he would not hand over the bag until she had told him exactly how many of each coin the bag contained. Her friends thought April would never retrieve her lost money. "How can anyone be expected to remember how many nickels or how many quarters were in a coin bag?" they argued.

Luckily, April remembered the sum of money she had and was able to recall the coin distribution.

April said, "I had $1.95 in the bag. I had 7 nickels and one half dollar, but I can't remember how many dimes or how many quarters."

"We can help you figure that out," her friends said excitedly.

After a while, the caretaker smiled and handed April her bag of coins. Can you figure out how many quarters and how many dimes she must have had?

10. During the summer months, Norwena gathers flowers for her mother's potpourri business. She must gather many pounds of flowers in order to produce a small amount of potpourri. When she gathers flowers five days a week, those flowers produce 50 sachet bags. She worked 5 days a week for one month. How many sachet bags were produced from the flowers she gathered?

11. Craddock's mother loaned him the kitchen to make cakes for his club house party. He will make twelve cakes. Kelley volunteered to help make the cakes. He asked Craddock to

give him a single chore. Craddock told him to unwrap all the sticks of butter needed for twelve cakes. Kelley said, "No problem. How many sticks should I unwrap?"
Craddock explained that each cake required 1 pound of butter.
"No problem," Kelley said.
"A stick of butter contains 1/4 pound," Craddock told him, "so figure out how many sticks you need."
Kelley needs help. Can you tell him how to go about figuring out how many sticks of butter he needs?

12. Harvey's Balloon Shop let go of 65 balloons into the sunfilled sky during a period of two days. The second day they sent up 25 more balloons than they did on the first day. How many balloons were sent up each day?

13. Dolly rides her horse every afternoon. Her horse's name is President George. One afternoon in early winter, Dolly decided to ride seven miles down the road to the country store. Usually, President George will trot three miles before Dolly feeds him an apple. After eating the apple, the horse gallops so fast Dolly nearly loses her hat. When she arrived at the country store, Mrs. Jenks, the owner, asked Dolly to deliver a package to a farm seven miles farther than the store. Dolly said she would be glad to deliver the package, but she needed more apples.
Mrs. Jenks was happy to supply the needed apples for the trip to the farm and for Dolly's return trip home. How many apples did Mrs. Jenks give Dolly?

Story Problems

14. Sterling is a champion swimmer in his city's youth league. He swims 10 miles every morning, eats 3 healthy meals, sleeps 10 hours every night, and spends an hour each day doing toning and strengthening exercises. He also enjoys long walks in the evening. How many miles does Sterling swim in a five day period?

15. Marty helps her cousins to recycle plastic bottles. Marty hauls her wagon around the neighborhood collecting bottles that the neighbors have saved. Once she returns home Marty sorts the bottles into two groups. Beverage bottles and others. Last week, Marty collected 50 bottles, and 30 of them were beverage bottles. How many were not beverage bottles?

16. Mindy landed on a strange island. Strange, short trees grew on this island. The first short tree grew 3 fruit; 6 fruit grew on the second tree; and 12 fruit grew on the third tree. A strange little woman appeared from a corner of the island and told Mindy that she could leave the strange island, if she could figure out how many fruit the fifth tree would hold.
Pretend you are Mindy. How many fruit will the fifth tree hold?

17. Jungle Jane collects lizards. She created an artificial jungle for their comfort, but her mother only allows her to keep them for one month, and then they must be returned to their natural habitat. The second day of the month Jane collected 5 lizards from the tr s around her tropical home; five days later, she collected 3 lizards from trees in her grandmother's yard, and during the middle of the month, her brother, Josh,

gave her 2 lizards he found near a tropical water pond. How many lizards did Jungle Jane depart with at the end of the month?

18. Crissy and Matty collect bottle caps from Rosetta's corner grocery store. For every 10 bottle caps, they get paid $0.05. If they collected 60 bottle caps in one afternoon, how much were they paid? **Hint:** Count all the bottle caps into groups of ten. Check to be sure you have 60.

19. It was lambing season, the time of year when ewes gave birth to lambs. Mrs. Campbell fixed baby bottles of milk in case any of the mother ewes could not suckle their young. Her husband ran in one time and asked for 2 bottles. The second time he asked for 5 bottles. The third time he asked for 8 bottles. When he arrived the fourth time, Mrs. Campbell handed the right number of bottles to him before he said how many. How many bottles did she hand to him and how did she figure it out?

20. Bella's Pizza Shop sliced 40 pounds of pepperoni in one afternoon, over a two hour period. In the first hour, they sliced 10 pounds more of pepperoni than they did in the second hour. How many pounds did they slice each hour?

21. Soft music played all day all summer in every park in Houston. As Inga watched the ducks swimming across the lake in her favorite park, she was sure the ducks heard and liked the music, as their graceful glide seemed in perfect sychrony with

the music. One duck bobbed her neck for every long note held. If seven long notes were held in thirty minutes, how many times did the duck bob its head? Inga counted.

22. Dr. Charles R. Drew's doctoral thesis was titled: "Banked Blood: A Study in Blood Preservation." This work is considered to have been the guide to the founding of blood banks. Dr. Drew supervised the entire project when the American Red Cross set up its first blood collection center in New York in 1941 for the American armed forces. Yet in 1950, Dr. Drew died from injuries sustained in an automobile accident, because the nearest hospital refused to give him a blood transfusion due to the fact that he was an African American. He did not receive the benefit of his own work.
How many years lapsed between Dr. Drew's setting up blood banks for the armed forces and his dying because he was refused blood?

23. Garrett A. Morgan was cited by the U.S. government for inventing the first traffic signal. Born in 1877, his mother was a former slave. Morgan obtained the patent for the traffic signal in 1923 and sold the rights to this invention to the General Electric Corporation for $40,000. He died in 1963. How old was Garrett Morgan when he died?

24. Tomatoes sat atop every computer in Jenni's classroom. At first she mistook them for apples. She counted 25 tomatoes. Mrs. Kippip reminded Jenni that school rules forbade anyone

to eat during classtime. Eyeing the tomatoes made her hungry. How many computers were in Jenni's classroom?

25. Dolls repaired at the local doll hospital wind up in children's arms eventually. Princess Maude was repaired during the middle of the week and Lady Marion was repaired on Saturday morning. Beth paid $12 to have the 2 dolls repaired. The repair lady charged her less than usual because Beth mended doll dresses for give-away every Monday afternoon. The usual cost of repair for two dolls is $20. How much of a discount was Beth given?

Section 4

"Arithmebuildity"

Create a Math Environment

Arithmebuildity

We learn by doing at any stage of life.

ARITHMEBUILDITY takes advantage of the mechanism of thinking processes roused into action when a project is assigned. Complete the project. Come up with an idea to illustrate concepts learned. Through pictures, graphs, or touchable (and maybe moveable) objects demonstrate a principle. Create tools to work with or build something which clearly represents an application of your skills and understanding.

When a learner is assigned a project, usually much forethought precedes actual construction. Some research, questioning, tinkering, and extensive analytical thinking unfold with its development. Our goal in **ARITHMEBUILDITY** is to challenge the learner to create, build, or simply arrange objects while pursuing a task that is basically mathematical. Some pursuits are extremely simple and can be completed quickly. Others demand more intellectual energy and time.

Please view these as suggestions or germ ideas. These are starter-goals which will require your further input. You may need to decide how to go about accomplishing a particular task, how many of each item to use, what additional items to bring in, and whether a given strategy needs revising. Age appropriateness for each **ARITHMEBUILDITY** requires your decision. The child of three may engage successfully in a few of these projects, and the seven year-old may gain knowledge from the same endeavor. Twelve to fourteen year olds who are

involved in Prealgebra classes at school or in homeschooling may gain insight from some arithmebuildities. Knowing your own child, you will possess experiences and insights that give you special knowledge about him.

In the home environment, parents are often showing a thirteen year-old how to perform a specific task while in the presence of a four year-old. This is good and desirable, for everybody benefits. Here, you end up having to break down information into digestible bits for a younger child because of her inquisitive questions, but you simultaneously manage to give understandable simplicity to the older child who may not have been able to verbalize nitty-gritty questions. For the schoolaged child who reads with good understanding, some of these arithmebuildities will not require parent guidance.

Right and wrong answers are not concerns. If you have further questions, consult a textbook or a math resource person.

HAVE FUN!

Create a Math Environment

A GEOARCHITECT

Using only a ruler, tape, and construction paper, create a 14th century English castle. Determine correct geometric shapes and establish correct proportions.

A SPACE ENGINEER

Using a ruler, tape, and construction paper, make one wing of an airplane. Allow the wing span to be in a 1:4 proportion to the body of the plane.

FARMER'S GARDEN

List the following vegetables in a chart: celery, tomatoes, carrots, egg plant, endive, sweet potato, corn, beets, broccoli, and spinach. Find the number of milligrams of vitamin A each contains. Make a chart comparing the vitamin A content of the above vegetables.

HOT-COLD

Fill one glass with ice and leave it to melt for ten minutes. Use a thermometer to measure the temperature. Record. Allow the glass to sit in a sunny corner for the rest of the day. Touch it often. When it feels fairly warm, take the temperature. Record.

Take 10 readings during a four hour period and graph your results.

RINGS & THINGS

Using a 10-inch, 12-inch, and 14-inch metal wires, form three rings. Position the rings in mud or play dough so that if you laid

three straight edges beside them, you would make a triangle. Position the same three rings so that if you laid four straight edges beside them, you would make a rectangle.

SQUARE NETS

Cut out a 10-inch square net from nylon netting. Using a large needle and red thread, sew an 8-inch square within the 10-inch square. Next, sew a 6-inch square; now, a 4-inch square.

Having formed squares within squares, count all the lines going down. How many? Count all the lines moving to the right. How many?

GRAM DEVICE

Build a measuring instrument that will weigh 1 gram of any substance. Test on several substances of varying density. Examples: shredded egg carton, marbles, dirt, cereal, pennies, and anything else.

STORE

Assemble empty cartons and food boxes. Rinse to rid of any food particles. Affix prices on each. Arrange items on shelves to play "Store."

RACERS

Using 4 plastic jars (3.4 oz.), hole puncher, strings, and a stop watch, carry out the following:

String 4 jars together. Lay down on flat surface, push, and watch them roll.

Measure a 24-inch track. Roll the mobile across the track.

How long did it take to reach the end? Try two more times. Divide the distance by the time in order to get the speed.

CAN DIAMETER

Arrange 10 cans over a large piece of drawing paper. Trace the base of each can. Use a ruler to measure the diameter across each base.

STEP BY STEP

Using single serving cereal boxes, 2" x 5" card strips, masking tape, and red nubby fabric try the following arithmebuildity to improve an understanding of counting. Build a 15-step stairway with the above materials. Lay a finger on each step as the number is called. Count again, calling each number, and placing a strip of red, nubby fabric on each step.

UNMARKED VOLUME

You will need water, a measuring cup, and an unmarked container. Determine and record the amount of water in the measuring cup. Pour water into the unmarked container until the container is filled. How much was used?

SPOON ILLUSION

Obtain a clear drinking glass and two spoons. Fill the glass with water. Place the spoons, handles up, inside the water-filled glasses. Do the spoons look larger inside the glass than they do outside? If yes, can you figure out a way to determine how much larger the illusion is than the real spoons?

RAILROAD TRACKS

Build a railroad track out of drinking straws. Measure the distance between the tracks. Measure the entire length of the track.

HYDRAULIC LIFT

Build a hydraulic lift out of drinking straws, match boxes, and cardboard discs (wheels). Use straight pins to hold things together. Try lifting various weights. What is the maximum weight that it will lift?

POPSICLE BRIDGE

Build a popsicle bridge. Determine the maximum weight that your bridge will hold without collapsing.

WINDOW SYMMETRY

Build a house using a cereal box. Show only one side: 6 windows located symmetrically around a door that swings out 1 1/2 inches.

3 SIFTERS

Make 3 sifters. Stiff paper and cheesecloth serve this purpose well. One sifter will dispense 3 grams of flour in a given measured time. The second sifter will dispense 1 gram of flour in the same measured time as the first. The third sifter will dispense 6 grams of flour in the same measured time as the first two.

How will you change the design for each sifter, since each is dispensing a different amount of flour in the same amount of time?

LIGHTER THAN A FEATHER

Think of one way to compare weights by measuring. Assemble wire, 2 cut-out circles from paper plates, a wooden pencil post on a 2" wood block. Build a weighing machine that will measure up to 2 grams. Determine the weights of several objects by comparting them with some known weights. Can you determine the weight of a feather on your construction?

CIRCLE FINDER

Cut out 6 circles on a thick cardboard. Place this cardboard over a cookie sheet. Remove the cardboard. Measure the cookie sheet into 6 squares and find a way to separate each square. Into each square, place a different substance. Grits, sponge, red beans, margarine, wire mesh, and thawed jello offer good variation.

Lay the cardboard over the cookie sheet.

Close your eyes. Use your finger to trace a circle around each substance. Tell whether you are in circle number 1 or circle number 6.

SPONGE GEOMETRY

Assemble 4 sponges: red, blue, yellow, and green. Cut out 4 triangles and 4 squares.

STYROFOAM PYRAMIDS

Cut out 1 cone, 1 cube, 1 pyramid, and 1 cylinder. Use styrofoam and scissors.

CRACKER SYMMETRY

Lay 4 crackers in a square configuration. Lay a string through the center, north-south. Look on either side of the string. Lay a string through the center, east-west. Look above and below. What do you notice in both cases? What can you say about sameness? Does one side look exactly like the other? Is one side the mirror image of the other?

WIRE SHAPES

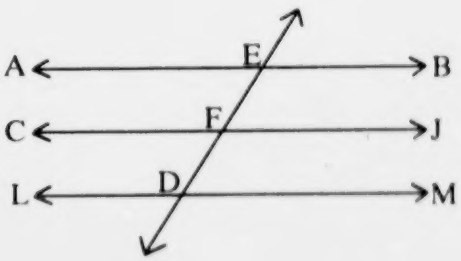
Using soft wire or hanger wire, bend two each of the following shapes: Squares Rectangles Triangles Pentagon Hexagon Octagon

MOLD GEOMETRY

A flour paste mixture or plaster of paris is required to carry this to completion. Make molds of the following geometric figures: Pentagon Hexagon Octagon. Let the molds dry and display them.

Create a Math Environment

Straight lines parallel to the same straight line are also parallel to one another.



Section 5

"Reinforcers"

Create a Math Environment

Reinforcers

Learning can take place anytime, anywhere. No definite parcels of time ensure that a concept is brain processed and retained. Understanding and application of principles reveal the extent of learning. Practice and drill reinforce.

Reinforcers in the math environment provide another way of viewing a concept. Sometimes, a game of math bingo allows you to recognize numbers without boredom or drudgery. Playing store provides fun practice with adding decimals or money, and scorekeeping for the baseball team encourages you to calculate averages or compare number size.

It is not always convenient for Mom or Dad to sit with Mickey for an hour reviewing fractions and percents when a big test looms on the horizon, but a computer drill will strengthen skills and knowledge for as long as he needs it.

In this section of **CREATE A MATH ENVIRONMENT**, you meet with simple suggestions on ways to help children retain math concepts already learned, to familiarize concepts briefly introduced, and to deepen understanding of concepts weakly held together. Frequently, reinforcers provide funtime for the math lover. Always, it provides the opportunity for each learner to become more competent and self confident in his abilities.

The objective here is not to instruct on how-to carry out the teaching-learning of a math skill. Rather, it is to toss out an idea and spur you to use your own means of follow-through.

Your creative juices are very important to implementing any ideas offered in this entire book.

Reinforcers

What makes the **REINFORCERS** work is your committment to your child's learning, tenacity in sticking with the goals you set, consistency in providing daily opportunity, and your flexibility in bending with time demands and further learning needs.

For the schoolaged child, reinforcers offer parents a litmus test to see if any knowledge has already been stored on a particular topic, like subtraction of fractions.

When you complete your plan for using the reinforcers, you will be taking an important, positive move to send your child forward.

- Leave down manipulatives for child to touch and explore.
- Put up posters having artwork that depicts arithmetic themes.
- Mount wall clock where child can see it.
- Recognition cards or flash cards can occupy place of importance in any room of your home.
- Let a counting frame decorate a kitchen table.
- Hang pictures that depict a set of things or geometric shapes.
- Read children's books whose basic themes are concerned with numbers.

Create a Math Environment

- Play special games that only emphasize math.

- Encourage everyday practice of flash cards for addition, subtraction, multiplication, or division, depending on child's age and coursework.

- Play with toy clocks.

- Play with toy telephones.

- Play with "play money."

- Play with any toys that teach number concepts.

- Provide opportunities to take measurements using a ruler.

- Look for graphs in newspapers or cartoons. Elementary school pupils will need help in interpreting graphs. Older children should be encouraged to discuss newspaper graphs with family adults.

- When shopping for grocery items, teach the child to round off numbers to the nearest tens or nearest hundreds. In many cases, rounding will be to the nearest hundredths.

- Encourage older children to estimate quotients.

- When shopping in the dairy department of a grocery store,

Reinforcers

point out pints and quarts to children of all ages. Show them that 2 pints make 1 quart.

- Figure out averages occasionally. The average amount of money spent on school lunches; the average number of bowls of cereal eaten per day by one family member.

- Show young children how to group. Group a large number of items into smaller groups of 2's, 3's, or 5's.

- Point out a comparison between two quantities. For example: Cindy's two cookies compared to Mike's five cookies, giving a ratio of 2 to 5.

- Practice counting by 10s.

- Practice counting by 5s.

- Arithmetic workbooks bought in variety stores offer good computation for the schoolaged child. Do not force a child so sit huddled over a workbook for long periods of time, unless he desires it.

- Encourage the learner to think up paris of numers whose sums are 10 or 100.

- Encourage the child to consult a calendar on a daily basis.

- Encourage penny banks or piggy banks, permitting the youngster to count his money often.

Create a Math Environment

- Rename Hindu-Arabic numerals as Roman numerals.
- Copy the number correctly. Check to see that your school aged child writes problems correctly as she copies them from a blackboard or textbook in transferring them to her own paper.

Number blocks and other math-related toys reinforce math concepts.

Reinforcers

- Encourage a collecting hobby, which will teach the child to categorize, sort, count, group, add, subtract, multiply, and to use other math concepts. Collecting baseball cards eventually leads to trading and that lends itself to development of several math skills.

- Study structures and equipment in everyday usage in looking for angles and lines. On a playground, study a slide. Does the slide form an angle with the ground?
  Look at the ceiling and walls of any room in your home. Do you see the upside down Ls formed between ceiling and wall? These are 90-degree angles.
  The ceiling and walls form perpendicular lines. Permit the child to point these out.

- Draw six shapes on separate cards. Cut each shape into two parts, using a dotted line. Help child to decide which shapes are cut in half by the dotted line.

- Practice subtraction activities during daily tasks.

- Permit children to take height measurements and weight measurements.

- Before numerals are introduced to very young children, teach them to **see** and identify a specific number of items. For example: Show Dennis 6 apples, telling him to look at 6 apples. Allow enough time for his brain to process this information. Later, in the same day, repeat this show and

tell. Next day, ask him how many apples does he see. Next day, present two groups of apples--6 in one group and 4 in another group. Ask him which group contains 6.

- Make large placards bearing each numeral 1 thru 100. Show a single placard to your young learner for an entire week, calling out the name of the numeral. You can begin with a one year old.

- Leave numeral placards up or laid out on a table or child's bedroom floor for the child's careful, uninterrupted examination.

- Praise children constantly for the progress they make or for clear understanding shown.

- At the end of every show & tell numeral session with your child, allow him to tell you what he **sees**.

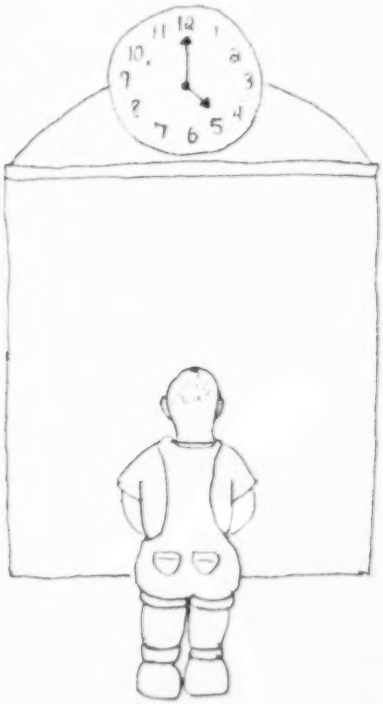
- Make placards bearing a certain number of blue dots. Without much talk, show & tell the child how many dots. Expect him to process this information. Spend only a few minutes showing but spend every day.

- Acquire number puzzles. Encouarge their use.

- Children should have some games, puzzles, and books that they can use by themselves, without adult guidance.

Reinforcers

- Read game instructions yourself before presenting to child. Are instructions simple enough that the child can read and understand by himself? Are the instructions clear enough that you will be able to explain clearly to the child, without confusion.
- Spend time matching number cards. Match numeral for numeral from different sets. Match numeral to picture, showing that number of objects.
- Buy an hourglass for the math center. Encourage the learner to play with it.



Carl watches the hour hand on the clock.

Create a Math Environment

- Puzzles should be an individual activity. It is better to give a child a puzzle that is simple than give one that is too complicated. If it is too simple, you will note that he is capable of progressing to something slightly more advanced. However, if it is too complicated, you may "turn him off" and never revive his interest, because his self confidence was undermined and his frustration was disheartening.

- Teach her to play checkers.

- Allow child to trace numerals using a stencil or other tracing devices.

- Listen to your learner count aloud. Check for correct sequence.

- Make a pegboard that contains 50 pegs. Make cards bearing numerals 1 thru 50¢. Teach child to hang the numeral cards on the pegs in the correct order. Nails can be safely driven into a square board to serve as pegs.

- Use a large size poster board or bulletin board paper and draw 100 square blocks to cover it. Also cut out 100 square cards that will fit over these square blocks. Write numerals 1 thru 100 on the cards. Encourage your learner to match these numerals.

- Occasionally ask your child for change, or pretend that he

has bought an item costing 50¢, and he has given the store clerk $1.00.
How much change should he receive? Vary the amounts for reinforcement of the concept.

- Teach the learner that he can add numbers in any order and still get the same sum. 2 + 3 = 5 is the same as 3 + 2 = 5.

- Show the learner that the order of operation for subtraction cannot be changed. 5 - 3 = 2 but 3 - 5 does not equal 2.

- Set out rrays of "play" money, allowing children to play with and familiarize themselves with coins and paper money at their own leisure.

- Provide opportunities for children to use recipes.

- During sharing of pies, apples, or other wholes, emphasize the fractions formed by cutting.

- Give blocks a special place in baby's (child's) bedroom. In family room, leave a stacked arrangement as you would an unfinished puzzle.

- Put up magnetized numerals on refrigerator, allowing child to manipulate these at his own will.

Create a Math Environment

- Encourage John to become treasurer of his club.

- Molly should be congratulated for accepting a job as the scorekeeper for her brother's little league baseball game.

- Clap as Bobby accepts a job as the statistician for his sister's basketball team.

- Role play careers like banker, accountant, engineer, and storekeeper.

- Build a birdhouse together. Let him measure the boards.

- Assign her the job of "map and mile figurer" before you leave on that 800-mile trip.

- Make good use of computers at the public library, school, or home. Make games or other instructional math activities provide excellent drill.

- Give a watch as a gift to a young child. Occasionally ask her the time.

- Assign your ten year old the job of checking the reading on the electric meter.

Materials Needed

2 red strings (8 inches each)
a square cardboard
6 blue buttons (any bauble will do)
circular tracks made of coat hangers
varied colored paper
strong yarn
1 clear plastic glass
red marking pen
tape measure
water
toy wagon or wheel barrow
ruler
protractor
large sheet of white paper
glue
scissors
red and green construction paper
tiny black construction paper dots
15 or more thread spools
15 or more lengths of thread
15 or more buttons
15 or more five-inch strips of cardboard
10 shoeboxes
20 envelopes
20 pieces of folded paper
white cardobard
red ribbon
green riboon
ice cube trays
water paint
brightly colored construction paper
large yellow pail of water
6 ping pong balls
small yellow bucket
small blue bucket
small red bucket
feather
cup
salt box

Create a Math Environment

10 small magnets
magnetic boards
brightly colored paper tape
marking pens
posterboard strips 4" x 10"
toy car
magic markers
toothpick flags
clock or watch
2 small baskets
20 similar smaller objects (like ping pong balls)
1 board cucumbers
egg cartons
pretend or plastic eggs
writing pad and pen or chalkboard and chalk
1 foot long plastic storage boxes
cardboard plate
a minus sign on a prop
an equal sign on a prop
writing pad and pencil
pencils
colorful chain of construction paper rings
paper chains with 10, 15, 20, 25, 30, and 40 rings
can of peaches
ice cream cone
balloon
square cutouts measuring 1 inch on each side
2 giant posterboards taped together
square cardboard measuring 10 inches on each side
rectangular cardboard 10 inches long and 2 inches wide
drawings showing various areas of squares and rectangles
squares and rectangles depicting the following measurements: 2x2, 2x3, 5x5, 5x6, 3x3, 3x4, and 4x9
felt or flannel board in dark color
36" flannel or felt
24"x32"piece of heavy cardboard
chalkboard
cardboard placards
collection of 20 similar objects
cardboard rectangles 4" long

Materials Needed

ruler
string
toilet tissue rolls or paper towel rolls (12 in. long)
assorted colors of balls or any objects
clock face made of construction paper (strip of sand paper on back)
15 lollipops
2 empty bread bags
4 clothes pins
empty toilet tissue rolls (cores)
box of cereal
Measuring pitcher and cups (pitcher should hold 1000 ml)
large bowl
5$ in coins
safe, empty containers
labels
8 quarters, 20 dimes, 100 pennies, 40 nickles, 2 half-dollars, 2 one dollar bills
plastic graduated cylinder
paper plates and cups
1 meter piece of fabric
meter stick
"1 meter long" objects
pipe stem cleaners
metric ruler
2 quart bottles
1 gallon jug
water and food coloring (red, green, and blue)
funnel
10 pennies, 10 dimes
masking tape
baby's bottle measured off in ounces
1 box of toothpicks
1 bag of gumdrops
30 or more playing cards
tape
knitting needles
glue
punched out paper holes
25 to 100 alphabet blocks
50, 3x3 size cards
100 deodorant container tops
1 large box
toilet tissue cores

Math Related Toys and Games

TOY OR GAME	DISTRIBUTOR
Alphie	Any toy store
Addition wrap-ups	Discovery Toys
Arithmetic Flash Cards	Grocery stores, variety stores
Bingo	Any Toy Store
Counting Scale	Child Craft
Counting Frame	Child Craft
Division Wrap-up kit	Discovery Toys
Dots and Colors	Child Craft
Developmental Maze	ABC Supply
Electro	Discovery
Electronic Tick-Tock Clock	Best Products
Equals	Beckley Cardy
Giant Key Calculator	Lillian Vernon
Jumbo size wood lacing beads	Any Toy Store
Kalah	
Measure Hunt	ABC Supply
Monopoly	Any Toy Store
Multiplication wrap-up kit	Discovery Toys
Number Muncher	Video Technology
Number Tiles	Any Toy Store
Play Money	Any Toy Store
Primary Watch	Lillian Vernon
Progressive Geometry Set	Child Craft
See-Saw Number Balance Scale	ABC Supply
Six-Slot Sorting Box	ABC Supply
Shape Sorter	ABC Supply
Speak n' Math	Any Toy Store
Subtraction wrap-it kit	Discovery Toys
Three Dimensional Challenge	Child Craft
Tomy Clock	Any Toy Store
Turtle Shell Shape Sorter	Best Products

Volume Relationship Sets	ABC Supply
Wood Train Clock	Lillian Vernon

Distributor Addresses

Child Craft Education Corp.	ABC SUPPLY, INC.
20 Kilmer Road	3312 N. Berkeley Lake Rd.
P.O. Box 3081	P.O. Box 100019
Edison, NJ 08818-3081	Duluth, GA 30136

*Check your telephone directory for a Discovery toy consultant

Create a Math Environment

Math Related Books For Children

BOOK TITLE	AUTHOR
Best Counting Book Ever	Richard Scarry
Big, Small, Short, Tall	Loreen Leedy
Circus Numbers	Rodney Peppe
Eating Fractions	Bruce McMillan
Leaves	Fulvio Testa
My Five Book	Jane Belk Moncure
Nine-In-One	Bila Xiong
One Duck, Another Duck	Charlotte Pomerantz
Over In The Meadow	John Langstaff
Prehistoric Pinkerton	Steven Kellogg
Seven In One Blow	Freire Wright and Michael Foreman
17 Kings and 42 Elephants	Margaret Mahy
Ten Little Rabbits	Virginia Grossman
The Biggest Pumpkin Ever	Steven Kroll
The Sesame Street Book Of Numbers	
Who Wants One	Mary Serfozo

Answer Guide To Quickies

1. GLORY'S AGE
   Glory is 10 years old. Glamor is 15 years old.

2. FRUIT BAGS
   If you look at a piece of fruit in the bag labeled PA and the fruit is a plum, then the bag should be labeled PP. If an apricot were picked from the PA bag, then the bag should be labeled AA. Since the other two bags are also labeled incorrectly, the correct label for PP is AA, and the correct label for AA is PA.

3. GRASSHOPPER HOPS
   The grasshopper may reach the leaf before she dies, but she will be awfully tired. Look below at the distances she jumps in trying to reach the leaf:

   16 x 1/2 = 8 cm
   8 x 1/2 = 4 cm
   4 x 1/2 = 2 cm
   2 x 1/2 = 1 cm
   1 x 1/2 = 1/2 cm
   1/2 x 1/2 = 1/4 cm
   1/4 x 1/2 = 1/8 cm
   1/8 x 1/2 = 1/16 cm
   1/16 x 1/2 = 1/32 cm
   1/32 x 1/2 = 1/64 cm
   1/64 x 1/2 = 1/128 cm
   1/128 x 1/2 = 1/356 cm
   1/356 x 1/2 = 1/812 cm

   *At this point you may conclude that the grasshopper is very close and in a few more jumps would land on the leaf.

4. ADD THE PAIRS
   1 + 8 = 9
   2 + 7 = 9
   3 + 6 = 9
   4 + 5 = 9

5. CENTURY PAIRS
   10 + 80 = 90
   20 + 70 = 90
   30 + 60 = 90
   40 + 50 = 90

6. THE HOT DOG CONTEST
The boys cannot even out the eating, but Beau and Lew can each eat 15 hot dogs for the triple to eat 50 hot dogs together. Therefore, Beau needs to eat 7 more and Lew should eat 5 more.

7. SQUARE TOOTHPICKS

10 toothpicks arranged to give 3 squares.

8. BEBEE AND PUPPY
5 balls. The puppy retrieved 5 balls.

9. TOY TRAVEL
Shea requires 20 minutes to overtake Chad after the 4 minute start-up. In that time (including the start-up time) both would have traveled 1200 feet.
Using a common sense approach, look below:

Total Time - Both	4 min.	6	8	10	12	14	16	18	20	22	24
Interval time	4 min.	2	2	2	2	2	2	2	2	2	2
Interval dist-Chad	200 ft.	100	100	100	100	100	100	100	100	100	100
Total Dist-Chad	200 ft.	300	400	500	600	700	800	900	1000	1100	1200
Interval dist-Shea	0 ft.	120	120	120	120	120	120	120	120	120	120
Total dist-Shea	0 ft.	120	240	360	480	600	20	840	960	1080	1200

10. BUD AND SUSAN
Susan's grandmother is 84 years old. Susan's grandmother is Bud's grandmother.

11. TRIANGLE TOOTHPICKS
Yes, you can make 7 triangles. In fact, 10 triangles can be made from the 21 toothpicks.

12. CAMEL CARAVANS
1500-300 = 1200 years old.

13. MONKEY SWINGS
The monkey must swing from limb 8 to limb 11, as if it counted as 1 swing. Continue from 11 to 19, in effect swinging through

15 consecutive limbs.
1→2→3→4→5→6→7→8→11→12→13→14→15→16→17→18→19

14. FIBONACCI NUMBERS
89, 144, 233
*To each number, add the previous number in the sequence.

15. SQUARE THE FIBONACCI NUMBER
1. You get the number, 1.

16. THE WATER FOWL BRIDGE
2 minutes. The front of the train takes 1 minute to cross the bridge, but Wanda is at the rear, and the rear of the train crosses two minutes after travel began.

17. PENNY AND THE PUZZLE KING
1. Penny was the only one going off down the long trail home.

18. DECOMPOSE A SQUARE
Yes, 5^2 can be decomposed to form 4^2 and 3^2
$5^2 = 25$
$4^2 = 16$
$3^2 = 9$

$25 = 16 + 9$

19. ODDS AND PRIMES
$11 = 7 + 3 + 1$
$15 = 11 + 3 + 1$
$29 = 11 + 3 + 5$

20. SIT TALLER
When Jeff stands 12 inches taller than Joe, Joe is sitting. When Joe sits half a foot shorter than Jeff, Jeff is also sitting.

21. SACK OF BALLS?
Yes. However, Molly did not use basketballs. She used a smaller ball, like tennis balls.

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22. WHO SAVED THE MOST?

At the end of 8 weeks, Roy will have saved $160 and Rhonda will have saved $255.

Roy saves $20 a week. In 8 weeks, he will have saved $20 x 8 = $160.

Rhonda saved by doubling the amount deposited the previous week:

1st wk.	2nd wk.	3rd wk.	4th wk.	5th wk.	6th wk.	7th wk.	8th wk.
$1	$2	$4	$8	$16	$32	$64	$128

Add: $1 + $2 + $4 + $8 + $16 + $32 + $64 + $128 = $255

Rhonda saved $255 over an 8 week period.

23. CREAM AH ICE

Cream costs 3¢ (three cents) and ice costs 8¢ (eight cents.)

24. UNUSUAL TIME TELLER

Four o'clock is sixty minutes til 5 o'clock.

25. THE ALLIGATOR'S TAIL

10.5 or 10 1/2 days.

*Change 21 feet into 252 inches. Change 1/2 hour into 30 minutes. Set up a proportion.

$$\frac{1/2 \text{ inch}}{30 \text{ minutes}} = \frac{252 \text{ inches}}{Y \text{ (an unknown number of minutes)}}$$

Y = 15,120 minutes

15,120 minutes ÷ 1440 minutes in 1 day = 10.5 days

*This problem can be solved by using a diagram and logic.

Answer Guide For Story Problems

1. 4 feet.

2. Yes. She can transport these babies in one trip. Kangaroo can carry two babies at one time, and two babies are left behind.

3.

4. 6.

5. Elephant number 6.

6. 1821 - 1513 = 308 years

7. 6 feet.

8. 3 weeks.

9. 6 dimes plus 2 quarters.
   4 quarters plus 1 dime.

10. 200 sachet bags. 4 x 50 = 200

11. 48 sticks of butter.

12. First day, 20 balloons sent up.
    Second day, 45 balloons sent up.

13. 6 apples for the horse.

14. 50 miles.

15. 20 bottles were not beverage bottles.

16. 48. Each number in the series doubles.

17. 10 lizards.

18. 30 cents.

19. 11 bottles. The bottle numbers were increased by +3 each time.

20. During the first hour, they sliced 25 pounds of pepperoni; and during the second hour, they sliced 15 pounds of pepperoni.

21. 14 times. The duck bobs its head 2 times for 1 long note. For 7 long notes, the duck bobs 7 x 2 times or 14 times.

22. 9 years.

23. 86 years old.

24. 25 computers.

25. $8.00 discount.

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Create a Math Environment

Glossary

absolute value: The distance of a number from zero.

addition: The process of finding a sum or two or more numbers.

angle: Two rays joined together in a common endpoint.

area: The number of square units that cover a region.

arithmetic proportion: An equation which says that two ratios are equal.

bar graph: A graph that uses columns to picture data.

cubic inch: The volume of a cube that is one inch long, one inch wide, and one inch high.

decimal: A fraction with a denominator of a power of ten, shown written with a point before the numerator. 7/10, for example, is written as .7.

diagonal: A line segment drawn from one corner point to another, without being a side of the plane figure it cuts through.

discount: The amount by which an item is reduced.

dividend: The number being divided.

division: Process of separating things into parts.

divisor: The given factor in the process of division.

exponent: A small numeral written above and to the right of another number. The 3 in 2^3 which specifies that 2 is to be used as a factor three times. $2 + 2 \times 2 \times 2$.

factor: Number to be multiplied.

Glossary

Fibonacci numbers: Each succeeding number in a Fibonacci sequence is the sum of two previous numbers.

fraction: Part of a whole.

geometry: The study of lines, angles, surfaces, and solids, along with their measurements.

graph: A picture used to show data.

hexagon: A six-sided figure.

horizontal axis: A line that goes across in an east-west direction.

integer: Positive and negative numbers used to describe different situations.

member: An object that belongs to a set.

meter: The unit of measurement for length in the metric system.

mixed numeral: A numeral having part naming a whole number and part naming a fractional number less than one.

octagon: An eight-sided figure.

odd number: A counting number that is not even.

one-to-one correspondence: A matching of one element in set A with exactly one element in set B.

pentagon: A five-sided figure.

percent: How many out of one hundred.

place value: The value assigned to a place where a digit appears within a number.

plot: To draw points on a graph.

prime number: A number that has two factors, itself and one.

quotient: The number that results when the dividend is divided by the divisor.

ratio: A fractional number used to compare two sets.

ray: A set of points that goes on without ending in one direction. It has only one end point.

rectangle: A quadrilateral with four right angles.

set: A group of objects.

square: A figure having four equal sides and four right angles.

square of a number: The product of one number multiplied by itself.

square root: A number is the square root of a second number if it can be multiplied by itself to produce the second number.

subscript: A figure (number) written underneath another to indicate placement. In 3_4 the 4 is the subscript.

subtraction: The process of taking away from.

superscript: A number written in the upper right hand corner above another number. It is actually the exponent.

triangle: A simple, closed curve formed by the union of three line segments.

vertical axis: An up-down line

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